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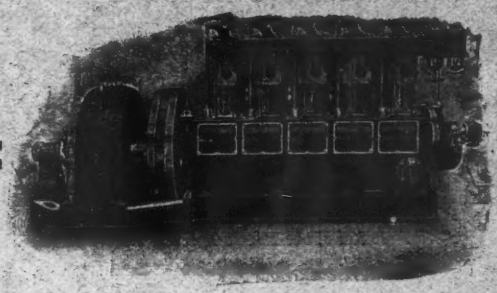

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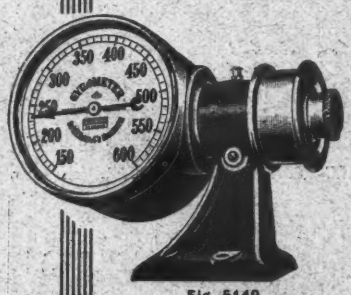

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ITALY'S ELECTRICAL AWAKENING.

ON several occasions, since the outbreak of the war, we have referred to the industrial awakening of Italy as a result of the difficult conditions created through the European conflagration, and to the revelation of the magnitude of the past dependence of that country in various directions upon German firms for the supply of different classes of manufactures. Mention has been made in particular of the determination of Italian electrical engineers to emancipate, if possible, the country from the domination of the Teutonic element, and attention has also been drawn to the important part which the Associazione Elettrotecnica Italiana, whose central offices are situated at Via S. Paolo 10, Milan, is endeavouring to play from the commercial point of view of the problem. A further step has now been taken by the Association, whose Ufficio Centrale has just issued, at the sole expense of the Society, a pamphlet of 130 pages containing a new and complete list of all firms who manufacture electrical machinery and apparatus, and giving technical and financial information concerning each of the 175 firms incorporated in it, as well as showing the origin and national character of each. It is stated that 10,000 copies are to be circulated for the purposes of propaganda among members of the Association, the Government offices, provincial and municipal authorities, technical and industrial associations, schools, &c., whilst other copies will be distributed abroad to the Italian Embassies and Consulates, chambers of commerce, &c. We believe that in their study of the Italian electrical position our manufacturers and traders will receive considerable assistance from this directory.

The Association is also moving in other directions. At a conference held at Florence, on October 29th, the question of organising professional schools was discussed at some length, and a resolution was adopted in favour of establishing museums and laboratories in connection with the technical schools, of introducing technical apprenticeships, and of forming a more concrete connection between the schools and the country. Of greater importance to circles outside of Italy, however, is the question of future Customs tariffs, which was raised by Engineer Gatta at the same conference. A resolution was eventually agreed to in principle asking that the new tariff system should be prepared as soon as possible. It was suggested that a maximum and a minimum tariff should be introduced, and the former be twice the scale of the latter; that certain items concerning machinery should be abolished or modified, and that a protectionist tariff be framed against foreign competition. The conference further had under consideration the question of the institution of a closer connection between the Government and manufacturers, and the president was requested to approach the Government with a view to the Association being consulted in respect of all legislative schemes concerning the electrical industry in general, and particularly in the case of projected utilisation of public waterways and the erection of telegraph and telephone installations.

It will be observed from the foregoing that Italy, like ourselves, France, Russia, and Belgium, has its own peculiar electro-industrial problems arising from the war situation. The electrical men of all these countries are possessed by the same inflexible determination to secure their emancipation from Teutonic influence. Each of the Allied countries

will desire to be self-dependent, utilising to the full its own resources and abilities wherever it is economically practicable to do so, but possibly, almost certainly, there will be directions in which Allied co-operation may fill in some of the gaps, mutual interworking rendering the Allies in the future independent of Germany and Austria for lines which without such co-operation might need again to be obtained from what are now obnoxious sources. It seems to us that there ought to be some way for the electrical authorities of all of the Allied countries that we have mentioned, who know thoroughly their own national electrical situation, facilities and possibilities, and also can speak with intimate knowledge concerning the schemes that are actually developing for meeting the situation, to confer together, putting their information, if need be, into a common pot, enabling the electrical activities of the Allies to be developed for the good of them all along the most intelligent, because the best informed, lines. We throw out the suggestion for what it may be worth, feeling that unless something in the way of personal conference is arranged, the Allied countries will fail to reap the fullest advantage from the many discussions and investigations that have taken place separately, and without any co-ordination, since the war began. There is nothing to be lost, but everything to be gained, by the cultivation of the closest possible relations between the electrical men of the Allied nations. Many of them, most of them, in fact, are mainly occupied with war activities at present, but it is not too early for somebody to take the lead, if only by way of preliminaries. What about the I.E.E. and the B.E.A.M.A.?

Is a Truce Possible?

We gather from the newspaper Press that a preliminary meeting is being held some time this week at which employers and Labour delegates will together consider the question of a basis for an industrial truce. It is understood that this will be quite a preliminary gathering attended by only a few representatives from either side, but it is expected to lead to larger conferences when both employers and employed will be represented by properly authorised delegates. We sincerely hope that this means that actual negotiations of a very definite character will soon develop. The atmosphere will not be improved if the matter be allowed to hang fire too long. We have evidence to this effect before us as we write, first, in the form of a report of a conference held last week-end at Leeds with the object of securing a fusion of all the existing Unions in the engineering trade "with the ultimate object of securing complete control of the industry." Mr. Tom Mann is reported to have declared that the Union officials were waiting for the rank and file to give them a mandate to "move towards obtaining the control of the industry." The resolution passed urged such control for the purpose of securing "the complete abolition of the wages system," and there was talk of the usual kind about "idle shareholders and capitalists." We fear that conferences of such a kind and resolutions of this nature will not help to create an atmosphere suited to the cultivation of industrial harmony. The other piece of evidence consists of a memorandum issued by the Employers' Parliamentary Council on "matters relating to the future of industry and the interests of employers." Here, again, there is a good deal of hard-hitting at the other side. No doubt much of it is justified. We quite agree that if the future is to be successful there must be *working* and not *shirking*, and that if higher wages are to be paid they must be *earned*; also that restriction of output and other curses of the past cannot be permitted unless we are going to court industrial suicide. But we are bound to recognise that the Government, wisely or unwisely, made a bargain with Labour involving the reinstatement of the old rules after the war; also that there has been wrong on the side of the employer as well as on that of the employed. The Leeds report and the Employers' memorandum seem to us to prove that, whatever the spirit of the trenches may be, Labour and Capital at home, if these two examples are to be regarded as typical of the feeling of the whole of the country, are still very far apart, and there is urgent need of a conference in which, with as little use as possible of the cudgels, they may seriously strive after that greatly-needed basis for a truce.

Science and Industry.

Elsewhere in this issue we print abstracts of two interesting lectures: one, on the life and work of, perhaps, the greatest scientific technologist that these islands have ever brought forth, by one of his most gifted pupils, Dr. Alexander Russell; the other, on the relations between science and technology, or, as the author prefers to put it, between "academic science" and technology, from the pungent pen of one, also a scientific technologist of high attainments, whose witty comments on men and things are now unfortunately only too seldom heard—Mr. James Swinburne. Widely divergent as are the points of view and the subject-matters of these two essays, there is nevertheless much in common between them. Mr. Swinburne delights in exposing the fallacies and delusions which we mortals hug to our breasts, and in attacking views which, by reason of their popularity, are generally regarded as orthodox, and in pursuing these aims he is apt to overshoot the mark, like most reformers; but we doubt whether he expects or intends all his remarks to be taken quite seriously. The career of Lord Kelvin, however, affords a striking illustration of some of the contentions which he puts forward. The early training of William Thomson was highly "academic" in the sense in which Mr. Swinburne uses the term, but the soundness of the solid foundation thus laid was abundantly demonstrated by the superstructure of technology which he erected upon it. As a teacher he achieved but a qualified success in imparting information; his energy and enthusiasm soon carried him far beyond the bounds of the subject chosen for the day, and his lectures sometimes ended on a topic very remote from that with which he commenced. But, on the other hand, as Mr. Swinburne remarks, he kindled in the hearts of his pupils a desire for knowledge and an appreciation of the delights of original research which far outweighed his deficiencies as a mere teacher of facts, and aroused in them an affectionate admiration which was reflected in the triumph of his jubilee at Glasgow. Moreover, we would emphasise the fact that many of his greatest achievements were the fruit of the untiring application of his mathematical genius not only to the practical ends of "technology," but also to what appeared to be the most abstract and unpractical problems of "academic science."

With some of Mr. Swinburne's remarks on the manufacturer and his problems we cannot wholly agree; that the British manufacturer, when he is on his mettle, is the equal of, or superior to, any in the world, we do not doubt, but the fact that he has problems to solve, and knows it, has been fully demonstrated during the war. As a case in point we may cite the electrification of textile fabrics, which is at present the subject of research at Leeds University, and this does not stand alone. The difficulty attending the publication of researches undertaken at universities has already been clearly recognised, and means are being devised to cope with it. As for Mr. Swinburne's child-like faith in the truth and virtue of economic theory, we can only say that in view of his iconoclastic tendencies in other relations, we are surprised at him. Is this his one weak point?

LINKING-UP ELECTRIC POWER STATIONS.

[COMMUNICATED.]

It is now pretty well agreed by everyone who has taken the trouble to investigate the matter, that material benefits are to be derived from linking-up electricity supply stations; but while there has been some progress in this direction, a great deal remains to be done before the full advantages of the scheme are realised. The difficulties involved in interconnecting the London electricity supplies are much more formidable than daily newspaper writers seem to imagine, for their idea, apparently, is that it is simply a question of joining together a few cables or wires, when a thoroughly reliable supply of electricity for London will be assured. Unfortunately, however, the problem is much more difficult. Had it been realised in the early days of the electrical industry that the coupling-up of electrical systems would, in time to come, lead to marked economy, as well as greater reliability and a reduction in the total amount of plant, it is more than likely that greater uniformity in voltages and frequencies would have been aimed at. As it is, stations have been erected with frequencies ranging from 25 to 100 cycles per second, and there is also considerable diversity in voltage. Even the frequencies of some of the larger and more recent stations which might advantageously be interconnected are not by any means in conformity.

In America, where coupling-up has been practised on a much greater scale than it has been here, very similar conditions prevail. The frequencies of the American stations are 25, 33, 40, 50, and 60 cycles. In the past there were 125 and 133-cycle stations, but these have now practically disappeared. The two frequencies most commonly used at the present time are 25 and 60 cycles, and there appears to be no very logical reason why any other values should be adopted in future. It is claimed that modern rotary converters will work quite well on 60-cycle circuits, so that there is no need to adopt 40 or 50 cycles on this score. The lower frequencies were originally adopted mainly with a view to facilitating the successful operation of rotary converters, for it is well known that the early 60-cycle converters were very troublesome machines. Some American engineers maintain that 60 cycles might now be adopted for practically all classes of service, apart from single-phase railways, but this, of course, is a matter of opinion. The lower frequencies impose limitations upon designers, especially in connection with speeds. Small two-pole, 25-cycle motors cannot run at a higher speed than 1,500 R.P.M., whereas 3,600 R.P.M. and intermediate speeds are permissible with 60 cycles. Twenty-five-cycle motors and transformers are also more costly to build than those designed for 60-cycle circuits; moreover, they are heavier. Transformers and motors of given output increase in cost and weight as the working frequency decreases. What applies to motors and transformers also applies to turbo-generators, especially those below 10,000 KW. capacity.

So far as America is concerned, there appears to be a distinct tendency to adhere in future to 60 and 25 cycles, and to eliminate other frequencies as occasions arise. To link-up American systems many frequency-changers have been built, and when similar work is seriously commenced in this country there will undoubtedly be a big demand for these machines. Having equipped our stations with complete disregard to the possibility of linking-up, we are in the unhappy position of having stations working at 25, 33, 40, 50, 60, 83, 85, 90, and 100 cycles per second. Moreover, there are many different voltages, and some stations supply single-phase current, a few two-phase current, and the bulk of the large and most modern stations three-phase current. There are also, of course, some three-wire continuous-current stations which may eventually be converted into sub-stations and fed from larger plants, or be interconnected with them, as in the case of other stations. In linking-up, the particular kind of current supplied to consumers need not be considered, unless it happens to be the same kind of current that is generated, for linking-up is done between station bus-bars and not between distributing systems. If it is merely a question of dealing with different voltages, no great difficulty is involved. By the aid of static transformers, switch-gear, and cables, stations having different voltages can readily be connected together. Two- and three-phase stations having the same frequencies can also be interconnected by using transformers connected in accordance with the scheme devised by Scott; but when it comes to coupling-up single-phase stations with two- and three-phase stations and coupling stations of different frequencies, the task is less simple.

The conversion of single-phase current to three-phase current, or *vice versâ*, cannot be accomplished with static transformers, even if the frequencies of the two stations are the same. A single-phase load represents power which is pulsating or varying periodically from zero to a maximum value, whilst a balanced polyphase load represents continuous power of constant value. Obviously it is not feasible to transform from continuous power to pulsating power, or *vice versâ*, without some method of storing and returning power. This result cannot, of course, be achieved with static transformers. True, attempts have been made to do this, and in some cases it has been possible to obtain equal currents on the three phases, but balanced currents do not necessarily represent balanced power loads. Equal currents in the three phases have been obtained by causing part of the current to lead and part to lag, but the resultant reactions and unbalancing effects of these lagging and leading currents have the same effect on the generating system as the single-phase load would have. To maintain a proper balance on the three-phase side when transforming from three-phase current to single-phase current a rotating machine must be used. The difference between the energy delivered by the three-phase system and that taken by the load is stored as part of the momentum of the set, and this stored energy is delivered as electrical energy at the proper moments. The inverse transformation from single-phase current to polyphase currents is, for the same reason as stated, impracticable without a revolving machine. A motor-generator consisting of a three-phase and a single-phase machine mechanically coupled together will, of course, give the desired transformation without any trouble at all, and where periodicity transformation is desired as well as phase transformation, a machine of this kind is absolutely essential. The single-phase and polyphase loads are then quite independent. But where transformation from single-phase to polyphase current, or *vice versâ*, does not also involve a change in periodicity, it would appear that part of the single-phase load could be delivered directly from one phase of the three-phase system, whilst the other part of the load could be dealt with by a phase converter. Phase converters, as used on the locomotives of the Norfolk and Western Railroad, might be employed for the transformation of three-phase current to single-phase current, or *vice versâ*, but their suitability for interconnecting systems has not yet been demonstrated. In a paper read before the Association of Edison Illuminating Companies in 1914, Mr. B. G. Lamme discussed the question of using these converters for obtaining single-phase loads from polyphase systems. The growing demand for single-phase current for working single-phase railways, electric furnaces, and so forth, has led American engineers to look into this question. As, however, the suitability of this type of converter for coupling-up purposes has not as yet been demonstrated, and as single-phase and polyphase stations having exactly the same frequencies are not often met with in this country, this particular kind of phase converter need not at the present time be further considered.

Synchronous motor-generators—*i.e.*, sets consisting of two synchronous machines mechanically coupled together—provide a positive coupling between the two interconnected stations; that is to say, if the speed of the steam sets in one station increases, that of the sets in the other station increases correspondingly. An induction-motor-generator, on the other hand, gives a certain amount of slip, and the coupling between stations is, consequently, not so rigid. This slipping property of the induction-motor-generator is an advantage in that an increase in the speed at one station is less liable to result in a large transference of load which may prove too much for the motor-generator. Owing to this difference in the characteristics of synchronous and induction-motor-generators, it is advisable, in

the interests of safety, to use synchronous motor-generators of sufficient capacity to cope with the full load of either of the interconnected stations. Evidently nothing serious can then happen, even if one station be completely shut down. The flexible coupling which the induction-motor-generator provides would appear to be its principal advantage, but it is to be noted that when an intentional transference of load is made, quite an appreciable difference in the speeds of the two interconnected stations is necessary. An induction motor that has, say, 3 per cent. slip when running at full load, will have to run 3 per cent. above synchronous speed before it will give full load as an asynchronous generator, so that if such an induction motor were used on a motor-generator, the transference of full load from one direction to the other would involve a difference in speed between the two stations of as much as 6 per cent. One station might, of course, run 3 per cent. high, and the other 3 per cent. low. A synchronous motor-generator set, on the other hand, will transfer full load from one direction to the other without any difference in speed at all.

It is sometimes claimed that induction-motor-generators are superior to synchronous motor-generators on the score of easy starting, but, in the light of modern practice, there does not appear to be much in this argument, for with a rotor on one side of the machine wound in the same way as the rotor of an induction motor, synchronous motor-generator sets can be started without a special starting motor, and it is only necessary to synchronise on one side. Such machines are started at reduced pressure with the aid of a compensator or auto-transformer, and when the machine comes up to speed, exciting current is supplied to the slip-rings. But when the machine is running in synchronism on the motor side, the generator voltage may, or may not, bear the proper relation to the voltage of other units, and before the machine can be paralleled at the generator end it may be necessary to slip the poles by reversing the motor field current; in fact, one or two reversals may be necessary before the correct relation is secured. When operating synchronous frequency changers in parallel certain small difficulties are met with which do not manifest themselves when running other kinds of machines in parallel. For instance, if one frequency-changer is carrying load, and it is desired to synchronise another frequency-changer with it, the switch should not be closed at the instant when the synchroscope indicates perfect synchronism. The load on the working machine acts like a mechanical drag on the rotor, with the result that there is a corresponding angular displacement of the revolving fields. To parallel two such sets satisfactorily, the switch should be closed when the synchroscope needle deviates by some angle from the exact synchronism mark, the angle depending upon the amount of load the working machine is carrying. When, however, the frequency-changers are both in the same station, the effect of closing the switch when the synchroscope indicates exact synchronism is not, as a rule, serious. But if the machines are in different stations, and it is necessary to parallel them over a transmission line or cable, the disturbance may be more pronounced. The resistance tends to lower the synchronising power.

In order that synchronous frequency-changers may operate satisfactorily in parallel they must either be made with extreme accuracy, both mechanically and electrically, or means must be provided for adjusting the stator of one of the machines composing a unit. The latter arrangement, which is provided on modern machines, enables the operator to obtain the desired division of load between different sets. The stator of either the motor or the generator is mounted in a cradle, so that it is capable of being rotated through a small angle. By the aid of a small motor geared to the movable stator and connected to a control switch on the switchboard, any desired division of load can be obtained with the greatest ease. If the steam sets in two interconnected generating stations are to run at their exact speeds, the combination of poles on a synchronous frequency-changer may result in the use of a frequency-changer running at only 300 revolutions per minute. In the case of small and medium-sized machines, this is a troublesome limitation, since it hinders economical design. In the following table, some pole combinations are given, from which it will be seen that 25- and 60-cycle stations call for a motor-generator running at this low speed.

Frequency.		Poles.		Speed.	Generator frequency.
Motor.	Generator.	Motor.	Generator.		
25	62·5	4	10	750	4·17 per cent. high.
25	62·5	8	20	375	4·17 per cent. high.
25	60	10	24	300	Exact.
25	58·3	6	14	500	2·78 per cent. low.
25	56·3	8	18	375	6·18 per cent. low.
60	26·7	18	8	400	6·8 per cent. high.
60	25·7	14	6	514	2·8 per cent. high.
60	25	24	10	300	Exact.
60	24	20	8	360	4 per cent. low.
60	24	10	4	720	4 per cent. low.

If it be simply a question of changing from one periodicity to another, and no interconnection between stations is involved, a periodicity on the generator side, which is slightly above or below the actual value required, may not in some cases be a very important matter; but when it comes to coupling-up generating stations, the conditions are, of course, different. With induction motor-generators greater flexibility can be secured, for with a little permanent resistance in the rotor circuit the slip can be adjusted, and the correct frequency on the generating side so obtained, although, unfortunately, permanent resistance in the rotor circuit involves a reduction in efficiency. Further, it is to be remembered that an induction motor cannot work as a generator unless it runs in parallel with a synchronous machine, for it always must take its exciting current from the line, and it always draws a lagging current, irrespective of whether it is generating or motoring.

Load cannot, of course, be transferred from one station to another by adjusting the field rheostats of the steam-driven generators. Such adjustments will simply give rise to a flow of wattless current. The manner in which the stations share the load depends on the setting of the engine or turbine governors, and not upon the exciting currents of the generators. With the governors in the two stations set for the same drop in speed from no load to full load, each station will automatically deal with its proportionate share of the load; if, on the other hand, the governors in one station give twice as much speed-drop as those in the other station, then, assuming that the capacities of the two plants are equal, the station with the closer regulation will take up automatically twice as much load as the other station.

Engineers must decide for themselves which of the two types of motor-generators will best suit their requirements. Of course, when it is desired to shut one station down completely, and feed the bus-bars of that station through the motor-generator, the induction-motor machine is useless, unless the motor happens to be on the running station side. Since an induction motor can only act as an asynchronous generator when it is running in parallel with synchronous machines, it follows that if the generating station to which it is connected be shut down, the motor-generator cannot take over the load. The synchronous machine, on the other hand, being excited on both sides with direct current, will, of course, supply current in either direction, irrespective of whether it runs in parallel with other machines or not. Moreover, it is possible, with synchronous motor-generators to correct the power factor on both of the interconnected stations. Hence, although there are, as shown, certain small difficulties in operating synchronous frequency-changers in parallel, these machines are, nevertheless, pretty extensively used.

When linking up continuous-current stations with alternating-current stations, rotary converters or motor-converters are employed. Motor-generators would, of course, answer the purpose, but since they are less efficient than rotaries or motor-converters, they are not, save under exceptional circumstances, likely to be adopted. The connections for the rotary correspond with the usual sub-station connections; that is to say, the slip-rings are connected to the alternating station through static transformers, and the commutator end is connected through suitable switches and circuit-breakers to the bus-bars of the continuous-current station. When the machine is transferring load from the con-

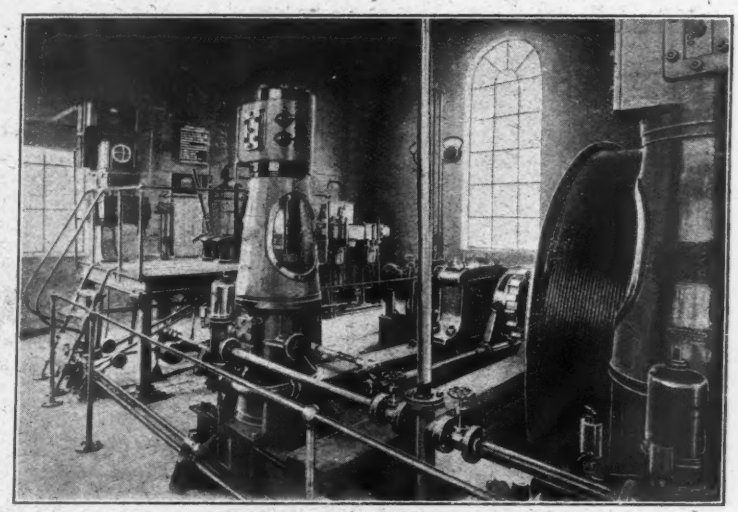
tinuous-current station to the alternating-current station the voltage generated by the rotary on the direct-current side must be a little below that on the direct-current bus-bars. To a certain extent the interchange of energy between the two stations is automatic, the two stations sharing the load according to the adjustment of the governors; but, as a rule, a certain amount of field adjustment is necessary. Of course, when the rotary is connected through the transformers to the alternating-current bus-bars, it runs as a synchronous machine and its speed is fixed, but if the alternating-current station be shut down and current is still drawn from the alternating-current side of the rotary it runs as a direct-current motor. The speed then depends upon the field strength, and if from time to time there is a material change in the power factor, caused, for instance, by the starting of induction-motors, the speed of the rotary may, as a result of the demagnetising effects of the lagging currents, vary considerably and attain a dangerous value. For such conditions the makers of motor-converters claim superiority. The best machine for these conditions is the motor-generator, since the generating and motoring sides are entirely independent of one another, but rotary converters have been used under these conditions by exciting the field with a separate exciter driven by an induction-motor taking its current from the slip-rings of the rotary. A small increase in speed results in a rapid increase in the exciting current, which compensates for the demagnetising effects of the lagging currents.

In connection with linking-up continuous-current stations with polyphase stations, an interesting suggestion has been put forward by Mr. J. S. Peck. It is well known that it is not easy to build large continuous-current turbo-generators, and in order to avoid the use of continuous-current generators running at turbine speeds two schemes are practicable. One is to gear a comparatively slow-speed dynamo to the turbine, and the other to couple a turbo-alternator to the turbine, and electrically connect the alternator to a relatively slow-speed rotary converter. If the latter scheme be adopted, then polyphase stations can be coupled up with continuous-current stations with very little trouble or expense. The current from the polyphase station would be transformed down, so that the pressure corresponded with that across the terminals of the alternator, and the mesh-connected secondaries would be connected, after synchronising, to the leads between the turbo-alternator and the rotary converter. With the transformers disconnected from the turbo-alternator, continuous current would be supplied to the bus-bars of the continuous-current station in the ordinary way; for, of course, under these conditions the polyphase station is not coupled up. If, however, the transformers were synchronised with the alternator and the rotary converter disconnected from the alternator, the latter could supply polyphase current through the transformers to the polyphase station; or with the alternator in the continuous-current station still disconnected from the rotary, current could either be supplied from the polyphase station through the transformers and rotary converter to the continuous-current station bus-bars, or current from these bus-bars could be supplied through the rotary and transformers to the polyphase station. Under the latter conditions, the rotary would work inverted.

When larger power systems are interconnected, the possibility of very heavy currents flowing in the mains at times of short circuits must be kept in view. The use of current-limiting reactances demands, under these conditions, very careful consideration, especially when the stations contain large turbo-alternators. When the stations are at a considerable distance apart, the transmission lines or cables interconnecting them provide a certain amount of protection; in fact, in the case of some of the large interconnected water-power schemes, nothing beyond the transmission lines has been necessary to keep the short-circuit currents within permissible limits, for the lines act in a similar way to reactances connected between sections of station bus-bars. But it is to be remembered that many of these water-power stations contain large low-speed generators with comparatively low short-circuit currents. Much depends on the sizes and characteristics of the plants and the distances between stations. On some of the interconnected systems in America, current-limiting reactances are used pretty extensively, and there is little doubt that as the capacities of stations in this country increase, and as one by one they are interconnected, this practice of using reactance coils in generator leads, between sections of station bus-bars, and in feeder circuits, will become more general than it has been hitherto.

ELECTRIC WINDING PLANT AT A YORKSHIRE PIT.

Messrs. Newton, Chambers & Co., Ltd., of Sheffield, have recently introduced an electrically-driven winding plant at their Staindrop Pit, Skiers Spring, near Wentworth Station, for the following particulars of which we are indebted to the British Westinghouse Electric and Manufacturing Co., Ltd., who supplied the equipment.



Controlling Gear of Winder.

The plant has two steel winding drums, 10 ft. in diameter × 4 ft. 3 in. wide, and is gear-driven by a 220-B.H.P. slip-ring induction motor.

The drums are capable of holding 420 yards of rope in one layer. One drum is loose on the shaft, and is connected thereto by means of a clutch, the clutch and brake gear being suitably interlocked. The engine is designed to raise and lower men from a depth of 350 yards, the assumed duty being as follows:—

Weight of cage and chains	2 tons.
Weight of men per wind	3,400 lb.
Circumference of rope	3·14 in.
Winding time	60 sec.
Decking time...	30 sec.
Distance between headgear sheaves	5 ft.
Distance between centre of drum and centre of headgear sheaves, not less than	80 ft.

The equipment is also suitable for use for sinking with a total unbalanced load, including the weight of the rope, of 5,220 lb., and for coal winding with a total unbalanced load not exceeding 5,220 lb. At present the winder is being used for sinking purposes, and is accordingly fitted with one of the drums only; as soon as the shaft is completed the second drum will be fitted, and the winder will enter into full winding service with two cages.

There are two brake paths, arranged one on each drum; the drum shaft is 13 in. in diameter, and runs in three

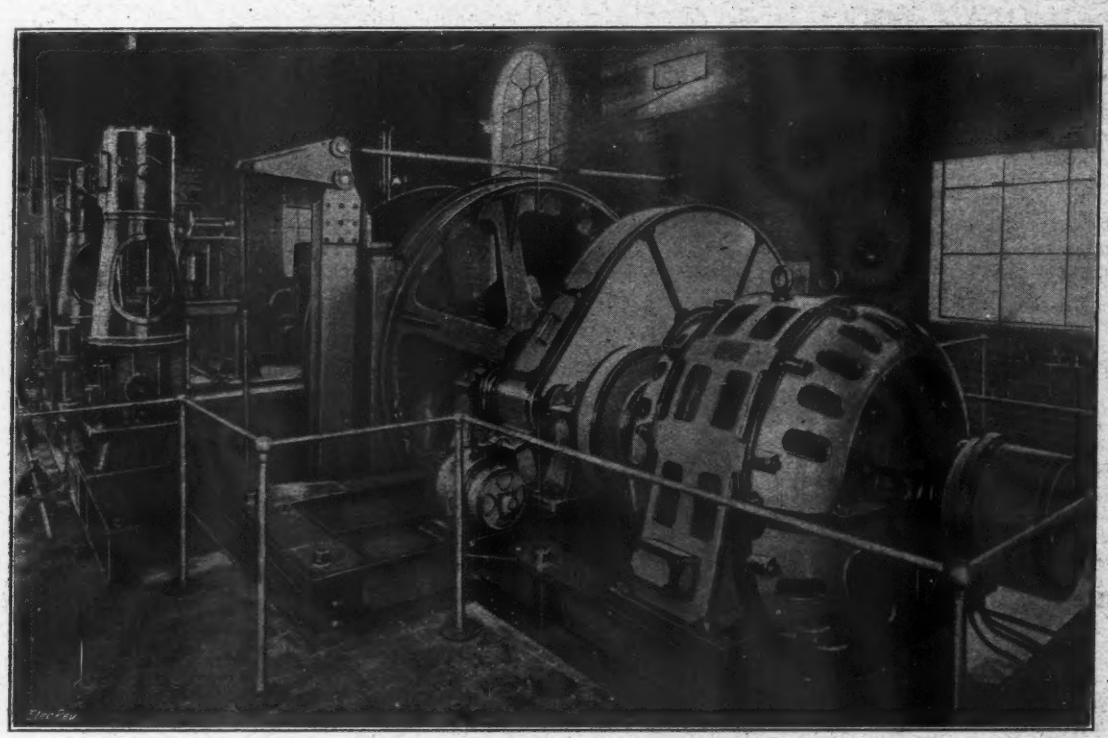
12-in. × 15-in. bearings, supported on a continuous channel-iron bedplate, which is extended to carry the motor.

The pinion is mounted on an independent shaft, running in two bearings, and is coupled to the motor by means of a flexible coupling. The brakes are of the post type, weight-applied, and controlled by means of an air-brake engine; they are arranged to come into operation automatically in case of overwind, overload on the motor, or failure of supply voltage. There is also an emergency lever included with the driver's control lever.

An auxiliary motor-driven air compressor, with receiver iping and fittings, is provided.

The depth indicator is of the vertical screw type, gear-driven from the drum shaft, and fitted with an overwinding trip.

The chief feature of the overwind limit-switch, fitted by the British Westinghouse Co. to all their winders, is the absolute safety obtained; also, the switch is so arranged that a second, or even a third, overwind can be dealt with should the driver accidentally start the winder in the wrong direction again.



Westinghouse 220-b.h.p. Motor driving Winder.

The driver's platform is sufficiently elevated to give the driver a full view of the winding engine, and carries the necessary control and brake levers, with quadrants and latches.

The motor is nominally rated at 220 h.p., and runs at a speed of 360 r.p.m., taking three-phase current at 50 cycles and 3,000 volts. It is arranged with the shaft extended to take a flexible coupling, and a trifurcating box is fitted on the motor frame for the stator connections. The motor is of specially robust construction, and is capable of dealing with overloads momentarily up to, and even exceeding, 2½ times full-load torque.

The controller is of the liquid type, with motor-driven circulating pumps and mechanically-operated reversing switches of ample capacity; the primary connections are fitted with trifurcating boxes. The controller consists essentially of two wrought-iron tanks, one mounted on the top of the other, a motor-driven circulating pump, electrodes for the rotor circuit, and two oil-immersed reversing switches. The bottom wrought-iron tank contains the solution, and is fitted with a cooling system; the solution is pumped from the bottom tank into the top one, flowing past the electrodes. The height of the solution in this tank, and therefore the area of the electrodes immersed, is governed by the height of the weir over which the solution has to fall before flowing back into the bottom tank. The weir is arranged for operation with the same lever as the reversing switches. The rate at which the top tank fills, and therefore the rate of acceleration of the motor, is adjustable by means of a stop valve on the delivery side of the pump. The cooling system is of the condenser type, with straight tubes, arranged so that the tubes can be cleaned by removing one end-plate of the system; or the whole system may be removed from the controller for this purpose. Any tube is easily replaceable if necessary.

The main switch-pillar is of the totally-enclosed type "S" design. It is fitted with a three-pole oil circuit-breaker, with two overload trips, two trifurcating boxes, and a mechanical attachment, by means of which the circuit may be opened in case the brake should be applied under any emergency condition. A hand-trip switch to put on the emergency brakes, if it should be necessary, is also provided, and is mounted on the platform in a convenient situation. The connections to the transformer are taken from the machine side of the main switch, the bus-bar chamber being fitted with interconnecting bus-bars for this purpose. To control the low-tension circuits to the solenoid controller, pump motor, and compressor motor, there are provided two sets of three-pole enclosed switches and fuses.

The auxiliary apparatus, also supplied by the British Westinghouse Co., comprises:—

1. A 10-k.v.a. three-phase, 50-period, 3,000/440-volt oil-insulated self-cooled transformer, to supply the solenoid controller, pump motor, and compressor motor.

2. A "no-volt" solenoid arranged to be operated by the emergency trip-gear for the brakes in case of failure of voltage, or through the action of the overload trips on the main circuit-breaker on overload, also by hand on emergency.

3. A set of driver's instruments, ammeter and voltmeter; these are of the illuminated dial type, with large open scales, and are mounted on a suitable bracket on the depth indicator, so that the driver can keep in view the instruments and the depth indicator simultaneously.

4. A squirrel-cage motor of 5-b.h.p. capacity for driving the air compressor.

5. A Westinghouse over-speed device, which can be arranged in conjunction with the other emergency gear to operate the brakes and cut off the supply of power to the motor in the event of a predetermined speed being exceeded

during any part of the wind, either acceleration, full-speed run, or retardation. This device consists of a small direct-current series-wound generator, driven from the shaft of the winding drum or motor, and arranged to operate in conjunction with a rheostat controlled by the depth indicator in such a way that a certain voltage is never exceeded, provided the acceleration or the speed is kept within a predetermined limit. In the event of the predetermined acceleration or speed being exceeded during any part of the wind, the voltage of this small machine rises, and so operates a relay in conjunction with the circuit-breaker and the emergency brakes.

The mechanical parts for the winding engine were supplied by Messrs. Robey & Co., of Lincoln, and the steel headgear in connection with the shaft was manufactured by Messrs. Newton, Chambers & Co. at their Thorncliffe Ironworks.

The current for the winding engine is generated at the Rockingham Colliery, which is about two miles away.

LORD KELVIN'S LIFE AND WORK.

In the eighth Kelvin lecture before the Institution of Electrical Engineers last week, Dr. Alexander Russell reviewed the life and work of Lord Kelvin, drawing freely upon his own notes and recollections of the great scientist.

William Thomson's first important paper—written at the age of 16, just before he entered Cambridge University—related to an analogy between the flow of heat in a conducting solid and the problem of the electrostatic field in an insulating medium. The lines of flow in the heat problem are coincident with the lines of force in the corresponding electrostatic problem. From the mathematical point of view the problems of thermal conductance, electrostatic capacity, and electric resistance are the same, and Dr. Russell points out that Thomson's work helps us to study how the resistance of the "earth" of an earthed conductor varies with the shape of the conductor which is in contact with the ground.

In 1844, being second wrangler and first Smith's prizeman, Thomson devoted himself to the investigation of physical problems with the help of mathematics, specially studying the problem of the distribution of electricity on two spherical conductors when near one another. Sir W. Snow Harris in 1834 had made careful experiments on the attractions between charged spherical conductors which seemed to throw doubt on the accuracy of Coulomb's law. Thomson therefore attacked the problem and obtained a complete solution, using the method of "electric images" with which his name will always be associated. This method is useful in the theories of heat, hydrodynamics, sound, &c., and also in pure mathematics. Thomson proved that the behaviour of electrified conductors as described by Snow Harris was in exact accordance with theoretical deductions from Coulomb's law, though he did not publish the solution of the problem until 1853. Similarly, in 1846 he gave the solution of the problem of the distribution of electricity on a spherical bowl—one of his greatest achievements—but did not publish the method of solving it until 23 years later; during this period no other mathematician had been able to supply a proof. By weighing the attraction between the spheres the voltage between them can be readily found, and Dr. Russell points out that this method can easily be applied to measure the voltage of high-pressure transformers; the voltage is completely determined when the dimensions of the spheres and the force of attraction between them are given, and in standardising a voltmeter of this kind no electrical measurements are necessary.

By 1851 Thomson had found that all the effects of electromagnetic and electrodynamic induction could be explained by the principle of the Conservation of Energy, and in that year he published a remarkable paper on the application of the principle of mechanical effect to the measurement of electromotive forces and of galvanic resistance in absolute units, in which he determined the E.M.F. of a Daniell cell approximately from the dynamical equivalent of the chemical action in the cell. He also pointed out that knowing the heat developed in a wire, and Joule's equivalent, if the current in the wire were measured in absolute units (with a tangent galvanometer, for instance), the resistance of the wire and the electromotive force could also be determined in absolute units; up to that time experimenters' results could only be expressed in terms of apparatus, cells, and wire in the possession of the observers. In many cases, therefore, it was impossible to compare their results. The idea of measuring resistance in absolute units was due to W. Weber, and Kirchhoff made the first determination in 1849. Thomson was the first, however, to show how the fundamental electric units could be determined from the principle of energy.

In 1853 Thomson read an epoch-making paper on the oscillatory discharge of a Leyden jar, explaining the reason why, as Helmholtz had observed, a steel needle magnetised by the discharge current from a Leyden jar had its north pole sometimes at one end, sometimes at the other. Thomson proved mathematically that the discharge was oscillatory in certain cases, and suggested that his conclusion might be experimentally verified by means of Wheatstone's revolving mirror, which was done by Feddersen in 1859. The invention of the oscillograph has enabled us to study these discharge currents in detail and prove that Thomson's theory is very approximately correct. The great practical importance of this paper lies in the fact that it led many physicists to study the problems of oscillatory discharge most carefully, and wireless telegraphy was the direct although unexpected outcome of their labours. It has to be remembered, however, that Thomson's theory is not complete. Of the energy originally stored in the jar we know that some is radiated into space. In many cases this amount is negligibly small, and Thomson's theory is directly applicable. But he did not show how the radiated energy could be taken into account or state the limitations of his formulæ.

In 1856 Thomson published a paper on the "peristaltic induction" of electric currents. The phenomena observed when testing submarine cables proved to him that the capacity effects between a wire and the sheath, or between neighbouring wires, were most important. In this paper he neglects the effect of electromagnetic induction, as this is permissible for slow signals. Thomson had very clear views about the electrostatic coefficients of neighbouring conductors. His work on the forces between electrified spheres proves this. He saw that when we have several wires in a cable and they have static charges the potentials of each wire can be found by means of these coefficients. This is still true when the charges are in motion. "They present a very perfect analogy with the mutual influences of a number of elastic tubes bound together laterally . . and surrounded and filled by a liquid which is forced through one or more of them." Borrowing a medical term he called this "peristaltic" induction. As the electricity was in motion it seemed to him illogical to talk about "electrostatic induction." He gave the solutions for cables containing two, three, four, and six wires, and Dr. Russell draws attention to the fact that the solutions of these problems are also the solutions of three-phase, single-phase, two-phase, and six-phase power-transmission systems. He left out of account the leakage conductance and the electromagnetic coefficients; but for a first solution of the problem it is wonderfully complete. Thomson's equations can easily be made rigorous and give the complete solution of the electric transmission of power in a polyphase system. The resulting equations are only a slight extension of the equations Thomson solved in 1851, the outcome of his thorough mastery of the problem of the electrostatic induction between two spheres.

After referring to Thomson's work in connection with the early Atlantic cables, and the invention of the mirror galvanometer and the siphon recorder (which was the prototype of the moving-coil galvanometer), Dr. Russell describes his investigation of the E.M.F. required to produce a spark in air between parallel metal plates, with the aid of his absolute electrometer, carried out in the cellars of the Old Glasgow College. His paper on sparking distances was the forerunner of many by other physicists, showing that the voltage at which the disruptive discharge occurs or a corona first appears depends on the maximum value of the potential gradient, provided that the electrodes are farther apart than about one-tenth of an inch. This question has become of importance from the engineering point of view in connection with the corona or brush discharge between overhead wires, the loss in watts per mile of single main being proportional to the square of the excess of the effective pressure between the mains over the pressure at which corona first appears.

Dr. Russell next discusses Thomson's work on the motion of vortex rings in a liquid or a gas, which he perceived was analagous to the magnetic forces due to an electric current flowing in a ring or to the magnetic forces due to a small magnet, and passes on to the theory of the conduction of heat, as handled by Thomson in 1881-2. Two years later he read a paper on the efficiency of clothing for maintaining temperature, and showed that under certain conditions the effect of clothing may be to cool a body. This leads to a consideration of the case of an insulated (covered) wire carrying a current, which has a less rise of temperature than a bare wire under otherwise similar conditions. Dr. Russell suggests that insulating overhead transmission wires with a suitable material would not only prevent the losses due to the formation of a corona, but would allow more power to be transmitted without overheating the wires.

Thomson devoted his best energies to determining the age of the earth and sun, and estimated that it was about a hundred million years since the surface of the earth was molten; but the discovery that a small mass of radium can emit spontaneously an enormous quantity of heat has made it probable that his conclusion will have to be modified. He was unable to accept the view that the energy of the radium (90 calories emitted per gramme per hour) could be derived from the element itself, and held that the energy was supplied by ethereal waves from outside.

Another subject dealt with by Thomson was the variation in the density of a high-frequency current in a cylindrical conductor over its cross-section; he pointed out that at very

high frequencies the current was practically confined to the surface of the conductor, and gave a formula for the effective resistance of the conductor, with tabular data which have been found useful also in other physical problems. The problem of the high-frequency resistance and inductance of a concentric main has been discussed by Dr. Russell on the lines laid down by Thomson, and in an appendix to the lecture the solution of the problem is given. These solutions, however, neglect the effects of capacity.

Various other examples of Thomson's activities are mentioned, such as his advocacy of the generation of electricity "in bulk" as long ago as 1878, of the use of the electric arc for street lighting in 1879, and of the development of the storage battery in 1881. The wonderful series of electrical measuring instruments which Thomson invented is also referred to; Dr. Russell states that three of his ampere balances have been in use practically continuously at Faraday House for the last 27 years under ordinary commercial conditions, and are as accurate and useful now as when they were bought.

The first published tests of lamp efficiencies were published by Sir William Thomson and Mr. J. T. Bottomley in 1881, and in this connection the author draws attention to interesting phenomena observed in testing the new gas-filled series lamps. In certain lamps, when rotated, the candle-power continually increases with the speed of rotation; at 180 revolutions per minute the light may be about 15 per cent. greater than when the lamp is stationary, and the current 1 or 2 per cent. less at constant voltage. These results are due to the effect of centrifugal force on the convection currents of gas inside the bulb and the rise in resistance of the hot tungsten filament with temperature.

The mathematical processes used by Thomson nearly always had a physical significance; he solved problems in one branch of physics by methods suggested by other branches, much of his success being due to his ability to grasp quickly the analogy between such problems. With pure mathematics he had little sympathy; he regarded it merely as a tool.

In conclusion, the author points out that he has dealt only with a few aspects of Lord Kelvin's life and work which are of general interest to engineers; as an imaginative thinker, a powerful reasoner, and a skilful inventor, Kelvin was probably unique.

The lecture was accompanied by a number of appendices relating to the subject-matter.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Final-Grade Classes in "Electrical Installation Work."

Glancing through a reprint of Mr. A. P. Trotter's recent paper before the Association of Supervising Electricians, we read that "elementary and advanced evening classes for electrical wiremen are held at the Northampton Institute, Clerkenwell, and at the South-Western Polytechnic, Chelsea."

This subject (formerly termed "Electric Wiremen's Work," and now much more appropriately called "Electrical Installation Work") is, of course, of fundamental importance, and is sought after by many other kinds of student besides wiremen.

While we know that Grade I classes are held at several different centres, it seems that we are to gather from Mr. Trotter's remarks that there are only two places in London where the Final Grade is dealt with.

If this be so, it is not too much to say that the authorities at other polytechnics and institutes appear to be rather neglecting an extremely necessary feature of their electrical side. Under its old name, the subject has been in the City Guilds' programme for the last ten years.

"Electrical Installation Work" is going on in practice in every district in London; and advanced as well as elementary instruction in the subject should certainly be available at every polytechnic and technical institute. We are not thinking here of the junior evening technical classes held at various Council schools. In their case it is obviously only possible to give very elementary instruction.

We venture to disagree with a previous statement in Mr. Trotter's paper: "The demand for trade classes in any special subject must precede the supply." As Mr. Trotter was addressing supervising electricians, we presume he was not thinking of "soap manufacture," or "leather tanning," or "cotton spinning," but of "electrical installation work." Now, why should this be looked upon as a special subject, when the work is going on all round us? Not one person in a hundred would trouble to ask for the establishment of a class that didn't already exist at his nearest technical institute. One obvious reason is that the applicant would think to himself that by the time the class was established, he would have learnt what he wanted some other way, or grown too old, or died. You might almost as well expect a person to ask someone else to open a shop because he wanted to buy something.

It surely stands to reason that classes in electrical installation work, in plumbers' work, in plasterers' work, and in other work which is common in every community should be conducted as a matter of course in every technical college in the country.

Apologising for trespassing so much on your space,

A. P. Lundberg & Sons.

London, N., *November 10th*, 1916.

[Referring to the last paragraph in Messrs. Lundberg's letter, we think our correspondents have in mind "trade schools" rather than "technical colleges," which do not, and should not, concern themselves with handicrafts. We agree, of course, that electrical installation work is an important subject, and ought to be taught in the advanced as well as the elementary stage.—EDS. ELEC. REV.]

Between Two Stools.

My attention has been drawn to the letter of "Victimus" in the current issue of the REVIEW. It would be extremely interesting to your readers, and necessary for their complete protection, to have the names of the persons concerned; they appear to be afflicted with the same species of moral hydrophobia as the Prussians, and it may prove to be equally desirable that they be isolated accordingly until such time as they may see and acknowledge the error of their ways. Ergo, full names and addresses, please!

Australian.

More About Discounts.

Some time ago a correspondence took place in the REVIEW *re* the needlessly complicated discounts in use. The Tungsten Lamp Association afterwards brought out their simple scale of discounts, which has proved a great boon, but, unfortunately, the cable makers so far have not followed their good example. The following account for B.C. cable, stupid though it is, is only a sample of thousands of accounts now being sent out. The account reads as follows:—

To Cable	£2	18 11
Less 20 per cent.		11 10
	£2	7 1
Plus 25 per cent.		11 10
The result of calculations is the original figure	£2	18 11

In other words, clerks are working overtime at night working out calculations like the above, when all they had to do was to put down the list price with the word "net" opposite.

In our school days we used to laugh at Chinese methods of working, but surely the Chinese must grin at us for employing staffs of clerks in war-time to work out discounts, when there is not any discount on the invoice. With our scrap-heaps of weights and measures, and absurd system of coinage, we have in some respects taken the place which the Chinese used to have, but which they are leaving behind.

The reason given for all the unnecessary complication in discounts, whereby we add so much and then deduct so much, is that sellers should know how to charge their customers. But this difficulty could easily be obviated by the use of a rubber stamp reading as follows:—

Note.—The retail selling price of these goods is ... per cent. above list.

The figure could be filled in by pen. This would ensure that all sellers were charged on the same basis. If this simple expedient were adopted by wholesale dealers, the saving of labour would be so great that quite a number of clerks could be released for the war. One feels that the matter only needs to be brought before the notice of those in authority for the change to be made. Perhaps those in touch with the accountancy departments of our C.M.A. firms (and many others also) will draw their attention to the problem, and point out that not only do they waste their own time, but also that of the overworked clerks in the offices of buyers.

Simplex.

"Summation Watt" Capacity of Field Rheostats and the Like.

Referring to Dr. Garrard's letter of November 6th, unless such formulæ are based on a physical meaning, *i.e.*, on the area enclosed by a curve plotted between (rheostat current)^2 and rheostat ohms, it seems to me to be of little use advocating any formulæ for universal benefit, as the limitations of different designs vary very considerably. In other words, unless so based a formula has no meaning except for comparison of an individual manufacturer's rheostats.

On this theoretical "summation watt" basis their relative accuracy can be tried out by those of your readers interested, and without further discussion.

To obtain a very large "R" in an ordinary rheostat compared with field, or other external constant resistance, increasing the resistance beyond a certain point does not materially increase the actual "summation watt" capacity required.

The greater the resistance in a potentiometer the less the

actual "summation watts," as the only variable (*i.e.*, constant watt loss) will be less.

Whether either above will in practice appreciably increase the size of rheostat (not the "summation watts") will depend entirely on the design and the particular case involved.

L. Boothman.

Stretford, *November 13th*, 1916.

SCIENCE AND INDUSTRY.*

By J. SWINBURNE, F.R.S.

A lecturer on this subject is expected to discuss the dependence of industry on mathematics, physics, chemistry, bacteriology, botany, and to a less extent a few other branches of science, such as biology, geology, and astronomy; and he is expected to show how the universities can help the industries of this country in two directions. The first is training men in the different branches of science, so that they can go into industrial work and be of the greatest value; the second is helping manufacturers directly by the advice of university professors and by carrying out technical research at college laboratories.

Many branches of industry are the direct application of scientific knowledge or discovery, made without any idea of its practical value. The foundation principle of wireless telegraphy is a good example of this. Again, few students of Routh's rigid dynamics would have thought of making a gyrostat serve as a compass. Problems of capillarity seemed to have only scientific interest, yet Elmore's process for the separation of complex ores and its various modifications, which have been worth hundreds of thousands to those concerned—except the inventor—depends on differences of surface tensions. In short, every industry in the country has its technology, or applied science, and the better this is understood by those in charge the better it is for the industry and for the country.

It is not my duty to discuss science as the root, or even a branch, of education in itself. To my non-expert mind, education ought to have four main objects. First, to enable one to earn his living, because if he cannot make his living nothing else is much use. Second, to let one know enough about his health to secure it. It is no use making a living or anything else if, owing to your own ignorance, your health is wrecked and you are prematurely buried. Third, to make one a good citizen. Fourth, to enable one to enjoy his well-earned leisure properly. These principles appear to be wrong, for they do not in the least fit education as commonly inflicted.

All the same, I will assume that under the first head there is a question of university teaching of science, with the object of its connection with industry. The main question is, then: How can universities best fit students to make their living by science in industry? To make the discussion complete, we ought also to discuss the question: How can business men make the best use of universities and of the men trained by them? This last question need not be discussed here, except in so far as the attitude of business men must react on universities attempting to work in conjunction with them.

In discussing its relation to industry, we must understand what we mean by science. Mathematics is the science of quantities and their relations. Pure mathematics is a study by itself. Mathematics may be applied to solve problems in astronomy, physics, mechanics, chemistry, and statistics. We thus have pure mathematics and applied mathematics. Sometimes the same man, Newton, for example, makes advances in both pure and applied mathematics. In science generally we have the same distinction. Science itself is a complicated fabric of organised knowledge of Nature. The man of science devotes his life to extend this fabric of knowledge in new directions, the object being to make the wonderful fabric complete in all its parts. In a sense this is of no use; but surely it is the noblest exercise of the human intellect. This is called pure, as opposed to applied, science, because it has no direct ulterior purpose. The term is bad, as pure and applied are not opposed, and all kinds of science are quite pure. I will, therefore, use the word academic to specify science pursued as an end in itself, without any regard to any external or ulterior use, the object of the pursuit being the attainment of knowledge and the development of the intellect. The word also fits as this kind of science is developed mainly by teachers.

Nearly all great advance in academic science is, and has been, made by professors in universities and colleges and their assistants—or in short by teachers. It might be supposed that a body undertaking the education of young men would choose the man best able to explain matters to students. This is not the practice, however. A university gets the most eminent scientific man available, or chooses a young man who promises to become eminent. He is given every assistance to make himself as famous as possible as a scientific discoverer; and apparently scientific distinction is his sole aim, the education of the students being of no account. This curious arrangement seems to work splendidly. It secures men of great ability, and they do good work, which would hardly be done otherwise at all; and instead of the students being neglected, they get fired with their leader's enthusiasm, and become assistants and co-workers, and eventually carry on the great work themselves.

We have thus academic science; we also have utilised science or technology. The technologist, as such, is not interested in the fabric of organised Nature knowledge, or academic science. He takes bits of the knowledge and uses them in manufacture. Sometimes the technologist is first, and his work is fitted into its place in academic science afterwards. Academic science generally develops it, so that the technologist is helped further forward. The technologist generally studies the branches of science which concern him till he knows more about them than those who have the more balanced knowledge of academic science. But this is not all: he has to look at matters from a different standpoint. He has always to consider prices and costs. He has to make his works pay.

Academic science thus does not cover technology. The knowledge is not there in the right form, and it is not in the right proportion, and it is entirely independent of all questions of cost, which are fundamental in technology. Here we have the great difficulty. The science teacher and the general public confuse academic science and technology, and think that the science taught at school or at the university is what is wanted in industry. This is a serious mistake.

The idea that academic science includes technology does harm in several ways. It prevents the science teacher understanding technology or realising what the manufacturer wants. It leads to his looking down on manufacturers as ignorant people, because they have not his particular kind of knowledge.

The question is, what ought universities to do? The obvious answer is that they should drop academic science and cultivate only technology. When a course seems quite obvious, and is not at once followed by competent people, it is generally wrong. If we dropped academic science we would drop technology, too, and lose all. Academic science depends almost entirely on universities, and great technological advance is possible only in conjunction with academic progress.

The spirit of academic science does not necessarily render a man less useful as a technologist. Quite the reverse. As long as it does not lead him to look down on technology, or to think he knows all about it without any special study, it helps him.

Whether it is possible to teach technology satisfactorily in college courses is an open question. A professor of academic science can be in the van of his subject, as he is himself taking part in it. A professor of any branch of technology must be behind his subject, as he has to learn from what is going on in works, which in many cases are not open to him at all.

I hold that the training at the university should be on thoroughly academic lines, because those are the lines on which the teachers are able to go far and well; and the whole of a student's available time is not too long to be devoted to a good groundwork of systematic coherent knowledge on which he can raise any desired superstructure of technology. The point I would insist on again is that he must not confuse the foundation with the superstructure. Many think that professors and schoolmasters are experts in education. You might as well say that a shunting engine is an expert in locomotion. It goes back and forwards along the lines for which it is designed. Those who take interest in the community want to get the locomotives off the old lines on to tracks suitable for the times, and such changes can be made by outside influence only against the bitterest conservatism.

Universities do now train men to earn their living by practice in law, and more especially in medicine and surgery. Nothing analogous is available in industry. Imitations of engineering and chemical workshops have always the drawback that they are only imitations. The elements of time and price do not come in, and they are vital.

Technical schools, unlike universities, have the definite object of training students to make their livings in industry; and they make their course as practical and as little academic as possible. A technical school is sometimes connected with a university; and we cannot in any case consider university training for industry without taking technical colleges into account. It must be admitted that if the best type of science training, even for industrial use, is the academic, the technical colleges are on wrong lines, and as technical colleges are doing splendid work, the idea put forward appears to be wrong. But it is not urged that the academic training is the best in every way; but that, on the whole, it is best because, first, the professors are able to effect it best; second, because a student has so little time to spare that it can best be laid out in acquiring a good, sound foundation; thirdly, a well trained mind with the academic can easily acquire the technical outlook, too; and, fourth, because academic science trains the mind to reason rather than to memorise, and deals with the facts of nature instead of the ideas or doings of other men just as foolish and illogical as ourselves. More than this, if the universities converted themselves into technical col-

* Abstract of a lecture delivered at King's College (University of London) on November 8th, and forming one of a series which will be published by the College in due course.

leges, academic science and with it technology would get moribund. Whether technical colleges are on the best lines is another question.

Recently we have heard a great deal about universities helping in scientific research. Research in academic science has little to do with national industry. All such research is published, and technologists all over the world utilise the results wherever the research is carried on. Research in academic science has no direct effect on national industry; but it has a great influence in rousing scientific enthusiasm, which is most important. But the outcry for scientific research for the benefit of industry is made chiefly by people who have no clear idea of the difference between academic and technical research, or of their circumstances. It is largely due to science teachers backed up by newspaper writers. The idea behind it is that manufacturers are ignorant and unscientific, and science teachers could put them right if allowed the chance. For example, we are told repeatedly that we are wasting coal, first, by burning it in badly-designed furnaces; secondly, by refusing to extract the valuable hydrocarbons and ammonia; and that it will soon be used up at present rates, and England will be ruined. The technologists know infinitely more about coal distillation than the science masters, and they know what can be done commercially now and what cannot. If the science masters made some discoveries that could be utilised, well and good; but to tell technologists that they are extravagant and ignorant is quite useless.

Can industrial research be carried on in teaching laboratories? During the war excellent work has been done, more especially in connection with such matters as dyes, drugs, and glass. In these cases we were merely taking substances that had already been made, and finding out how to make them. Finding out how to produce an existing dye is little in comparison with inventing the dye.

The vague idea seems to be that manufacturers have a number of definite problems they want solved; but they are too ignorant to solve them. They ought, therefore, to seek the advice of the universities, who would put them right. Manufacturers have no such problems. Half or more of the merit of an invention is realising that an improvement is wanted in any particular machine or process. One of the greatest difficulties the inventor has is to discover the "long felt want."

Take the question of recovery of hydrocarbons and ammonia from coal; students may carbonise coal in bits of gas barrel, distil tar, and fractionate the distillates and investigate them; but everything will be on a small scale except the mess. It is not the least likely undergraduates would find out anything in this way, and teach it to manufacturers; and they would be merely wasting time, and learning practically nothing.

But even if a research on tar distillation, for example, could be carried out satisfactorily in an educational laboratory, it could not be carried out in connection with an industrial distiller, because he would not work in with the laboratory unless he was to have a monopoly of the result. If the work is for publication, the tar distiller is not in the least interested, as it concerns his rivals here and abroad as well; so he will give neither information nor help. Results which are to be the common property of all, British or foreign, do not appeal to the individual manufacturer.

There is also a confusion between research and invention. It is not the least use turning a man or a group, and, least of all, a committee, on to invent. Industrial progress depends on invention, and we are the most inventive people in the world; not because we are the cleverest, but because we are the most individualistic, and the least benumbed by education. Inventions may be divided into two classes—improvements in machines or processes which can be made only by those in close touch with them inside the works; and broad inventions, which are generally made by complete outsiders whose minds are not in conventional grooves. In neither case can the university help.

Nothing is said about the shortcomings of the manufacturer, because I am not addressing him. He will not employ scientifically trained men, and he will not think very much of science generally until he finds that the technically-trained men come to the front. English manufacturers are, I maintain, the most competent of all. Eventually they may be better and they may employ science more; but to get them to do so science must adapt itself to industrial application.

Industry does not by any means depend alone on the types of science we have discussed. As a whole, it may be helped by the members of the community knowing something of economics, and acting on their knowledge; and it can be obstructed very effectively by the well-intentioned interference of those who know nothing of economics.

Economics is a curious science. Though it is broadly about wealth, it does not help the individual to become wealthy. To an engineer the skilful application of the knowledge of the various physical sciences means success in manufacture, which is good for him, and, being good for him, is good for the country. But a study of economics will not help him directly in his business at all; it is useful to him only as helping to make him a sensible citizen. He becomes a unit of sound opinion on labour problems, and on the action of Government in connection with industry. Unless, therefore, a man has the peculiar bent of mind which makes such a subject interesting in itself, he has no motive to lead him to read economics, until he recognises it as a duty he owes to society.

Economics is peculiar in another way. But a man who is sublimely ignorant of economics is quite unconscious of his blind spot. He will lay down the law on such subjects as the relations of Capital and Labour, the birth rate, old age pensions, and, especially, international and colonial trade, with a cock-certainty, and a wealth of catch-words and circumambient balderdash that is almost good enough for a leading article in a daily paper. More than that, he will insist on acting according to his darks, and he is one of the units that determine the acts of the nation.

That economics is not taught efficiently is abundantly clear not only by the nonsense talked by what we call educated men on questions involving it, but more especially by the fact that people do not seem to realise that there is any such science. As to politicians, they do not limit their ignorance of science to economics; they make hay of all sciences and all facts with impartial irresponsibility.

Not only the industry of the country, but the happiness of our people may depend on economics. At present we have practically the whole of the hand-working classes dissatisfied, and, therefore, unhappy. The social problem is the most important in the world at present. Its solution must depend on economics. Is it not worth while to study economics with such a purpose, instead of trying all sorts of schemes which are economically pernicious? It may be true that economics has not so far provided any cut-and-dried way out; but until people realise that the science which ought to shed light on this path exists, and that it ought to be studied and developed, drawing the best intellects to it, there is no hope for any end, or even alleviation, of the miseries of civilisation. I would urge that the first step is for the universities to teach economics, in which I include closely related branches of sociology, with the vigour and insight the subject deserves.

There is a popular delusion that business has to do with economics, and that business men understand economical matters in a peculiarly practical way. In fact, the business man is the most dangerous of all, because he knows no more of the subject than other people; and he is not only unconscious of his ignorance, but he is, if possible, more certain he knows all about the matter. The opinion of such a body as a chamber of commerce on after-war trade conditions is most dangerous. It will be accepted as authoritative, it will be stated without any alleged reasons, and it will almost certainly be wrong.

Such a calamity as the war is not broadly somebody else's fault. It is the fault of all of us, but especially the fault of education, of which universities are at the head, in not educating us in such a way that such a catastrophe is out of the question.

Broadly, the great change wanted is in public opinion. Until people consider knowledge of the world we live in and the economical, sociological conditions of our life, as coming first, and the study of the sayings, doings, and languages of other men, especially of those that lived when the knowledge of everything except human nature was in its babyhood, as quite secondary, we will no doubt go on with all the miseries of poverty, disease, discontent, and war.

WAR ITEMS.

Exports to Liberia.—The "London Gazette" for November 10th contains a list of corrections in the names of persons and bodies of persons in Liberia to whom exports may be consigned.

Japan and Enemy Trade.—A Tientsin dispatch in the *Westminster Gazette*, states that the forthcoming Japanese enemy trading legislation is very drastic, and provides penalties for indirect trading with the enemy similar to those imposed by the French system. Promulgation of the new laws is expected shortly.

Foreign Trading Prohibitions.—The "London Gazette" of November 10th contains further lists of persons and bodies of persons with whom trading is prohibited, under the Trading with the Enemy Act, in the following countries:—Argentina, and Uruguay, Bolivia, Brazil, Chile, Colombia, Denmark, Ecuador, Greece, Japan, Liberia, Morocco, Netherlands, Netherlands East Indies, Norway, Persia, Peru, Portuguese East Africa, Spain, Sweden, Venezuela. A number of removals from, and variations in, previous lists are also given.

To be Wound Up.—The Board of Trade has ordered the following companies to be wound up under the Trading with the Enemy Amendment Act:—

Radium, Ltd., 98, Mortimer Street, London, W., dealers in radium preparations. Controller: C. R. Beeby, 66, Basinghall Street, E.C.

Corner & Co., Ltd., 83, St. Paul's Churchyard, E.C., transfer manufacturers and dealers, and luminous and glass sign makers. Controller: P. Leask, St. Mildred Court, Bank, E.C.

Milnes Daimler Mercédès, Ltd., 135, Long Acre, London, W.C., motor-car company. Controller: F. G. van de Linde, 4, Fenchurch Avenue, E.C.

Leaving Certificates Refused.—At the Newcastle Munitions Tribunal, a tester's assistant in electrical apparatus works applied for a leaving certificate on the ground that her present occupation was detrimental to her health, and that she had a better position to go to. She did not put in a medical certificate, and the application was accordingly refused.—At the same sitting an application for a leaving certificate by an assistant driver with an electric supply company was also refused.

Hard Labour for Restricting Output.—According to the *Morning Post*, George Morris, local Secretary of the Workers' Union, was prosecuted at Coventry by the Ministry of Munitions for an alleged attempt to restrict the production of war material. The work of three men was affected. The Justices convicted, saying that the machines were idle because of the defendant's action. They felt the penalty must be substantial, and sentenced Morris to three months' hard labour. Notice of appeal was given.

Lord Balfour's Committee.—According to a statement published in the *Daily Chronicle*, Lord Balfour of Burleigh's Committee has had before it an interim report which will "probably be found to favour the prohibition of all imports from enemy countries for a period after the war." It is added that some members favoured a one-year period, and others a shorter term.

The *Times*, commenting on the same matter on Tuesday, said that there was some disappointment with the slow progress which had hitherto been made by Lord Balfour's Committee. "It is understood that the Committee will meet more frequently in future. The first and most urgent need is an Imperial trade policy, and the demand for the assembling of an Imperial Conference becomes steadily more insistent."

The Union Cable Co., Ltd.—In the House of Commons, on November 9th, Mr. George Terrell asked the President of the Board of Trade whether approximately 96 per cent. of the share capital of the Union Cable Co., Ltd., was owned by the Deutsche-Kabelwerke Co. of Berlin, and whether this company was still continuing to carry on its private trade in competition with British firms under the direction of its pre-war manager. According to the *Financial Times*, Mr. Pretyman replied that the share capital of the Union Cable Co. was held as stated, but the Public Trustee had now negotiated a sale of the shares to British subjects. The tenders made by the company to the Corporation of Coventry were investigated by the supervisor of the business last March, and he reported to the effect that the tenders were at a price which showed a fair trading profit. The company was subject to the same provisions with regard to income-tax and excess profits tax as any other company carrying on business in this country.

Exemption Applications.—At the Southampton Tribunal, the cases of between 30 and 40 tramway employés of the Corporation were considered. Ald. F. A. Dunsford, the Chairman of the Tramways Committee, told the Court that out of 350 men originally employed by the Tramway Committee, 150 had joined the Colours. The men were dealt with in groups, according to their occupations. On behalf of the chief clerk at headquarters, it was urged by Mr. Robson, the tramways manager, that his work was of the most intricate character, and it had taken him 15 years to acquire his knowledge of tramway methods. Three months' final was given. Pleading the cause of 19 motormen of military age, all married, Ald. Dunsford explained, according to the local Press, that they were all men of tried experience and many years' service. Young and less experienced men in the darkened streets at the present time were a danger to the public and themselves, and he appealed most strongly for exemption, if they were to keep the service going, and take the munition workers to their work. If these men were taken, the service would have to be curtailed.—Eleven of the men, all over 35, were granted conditional exemption while in their present occupation, six were given three months' extension, with leave to apply again, and the remaining two were given till January 1st, final.

At the Barnes Tribunal, the renewed application by F. H. Fiford, electrical engineer, was considered at some length, it being the view of some of the members of the Tribunal that if applicant was called up there would be no one in East Sheen available to do electrical work in cases of emergency. Exemption for two months.

At Nuneaton, on November 7th, Mr. P. H. Howe (28), electrical engineer, asked for exemption beyond November 1st, and stated that he had a number of motors to attend to. He was allowed until February 1st.

At Maidstone, Mr. Oswald Jones, electrical engineer, asked the Tribunal to reconsider their decision with respect to two men recently appealed for, but the request was refused.

At Canterbury, on November 6th, Mr. C. A. Blascheck, chief engineer at the city electricity works, appealed for Mr. Tapsfield, shift engineer, and stated that, including himself, the staff now numbered 17. Before the war they had five shift engineers; now there were only three, and he had no stand-by men at all. Mr. Arrowsmith (Military Representative): I do not think we can reduce the staff of the electricity works any more. The point is whether, instead of granting a conditional, it would not be wiser to grant a temporary certificate. The Mayor: That is what we have done. Three months were allowed, Mr. Blascheck being asked to do his best to get a substitute.—The Military applied for the withdrawal of a conditional certificate granted to G. B. Pearson, late of the electricity works staff, and who has taken a similar position at Marylebone, London. Mr. Pearson wrote stating that he had tried to get a commission in the Royal Engineers, and into the Air Service. Mr. Arrowsmith stated that exemption was granted because at Canterbury they were short of men, but they did not know anything of the circumstances prevailing in London. He asked for the cancellation of the certificate, and let the matter be dealt with in London. The conditional exemption was withdrawn.

At Lewisham, an electrical engineer (35), passed in Class C 1, applied for exemption, and said that there was a great demand for skilled electrical engineers. The Military Representative said that they could do with applicant for electrical engineering work in the Army. The appeal was refused, and applicant said that he should appeal.

At Wolstanton (Staffs.), the Bradwell Joint Isolation Hospital Committee applied for the retention of their electrical engineer, and three months were conceded.

At Oxford, Mr. J. H. Grant appealed for E. G. Syratt (36), electrician, engaged on work at Cowley Barracks. The Military Representative said that the work at the Barracks could be allowed to slide. The Tribunal refused exemption on condition that the man was employed by the Army as a fitter. Mr. Grant said he should appeal.

The North Metropolitan Electrical Power Supply Co., Ltd., appealed at St. Albans for further exemption for A. Brown (25), senior clerk and cashier, passed in Class B 1, but the appeal failed.

An engineer in charge of an electrical pumping plant was applied for by Mr. A. U. Kemsley, of Shoeburyness, and he was allowed until December 14th.

Before the Newcastle-under-Lyme Tribunal, on November 3rd, a fitter and an engine driver were appealed for by the Corporation electricity department. The Military Representative suggested that the electricity and gas works might very well be merged into one, instead of being worked separately. The Mayor said that they were working the electricity works with the minimum of labour, and the engineer stated that the demand for current was double what it was before the war. He could not keep the works going with a less staff. Col. Heath suggested women labour. The Mayor: Is it possible for you to substitute a woman for one of these men? The Engineer said that he would try and substitute the engine driver by a woman. Each was given exemption until the end of the year.

At Stony Stratford, a Swiss firm, contractors for the electrification of railway trains, applied for an employé at Newport Pagnell. The Military Representative urged that the new electric trains were not a necessity, and that the war was of more importance than a foreign company's work. The firm's manager said that they were winding up for the time being until after the war. Asked if they imported all their material, he replied, "One-third of the stuff we use comes from Switzerland. All the raw material is bought on the English market." A member: It's a mystery to me how the thing is ever allowed to go on—stuff like that coming in from Switzerland! The appeal was dismissed, with a month's grace.

Before the Farnham Rural Tribunal, the Electric Light Co. appealed for three members of the staff—an improver (20), a junior shift engineer (21), and a night cleaner and switchboard attendant (24). The Chairman intimated that the company could not be permitted to retain men of such age, and the appeals were respited for a month for them to be replaced.

An electrician at Cuckfield (Sussex), who is nearly 41, and has just received his calling-up notice, has been given 14 days' exemption only.

At East Ham, three months' exemption has been allowed to A. Oughton (41), a picture palace electrician.

At Folkestone, W. R. Varley (39), electrician at the Playhouse, passed for labour abroad, has been conditionally exempted.

Two motormen with the Mexborough and Swinton Tramway Co. were appealed for at Rawmarsh. One was given nine weeks, then to be medically re-examined, and the other was directed to go before the Medical Board forthwith.

At Sheffield, the India-Rubber Co. appealed on business grounds for the retention of H. S. Harrison (37), electrical assistant, and he was given until the end of January.

Colchester Corporation Electricity Committee appealed, on November 6th, for a stoker, on the staff for a year, but fully competent. Exemption was allowed until the end of the year, with the hope that the stoker will be replaced by that time.

Mr. T. Anderson (21), partner in a firm of electrical engineers and armature winders, appealed at East Ham for conditional exemption. Appellant's brother, who is the senior partner, said that he himself had been rejected on medical grounds. The firm had a number of large contracts, including one for the War Office. Exemption was refused.

At Walthamstow, the Fuller Electrical & Manufacturing Co., Ltd., appealed for P. Smith (29), electrical engineer; S. Eckett (29), electric motor winder; and C. H. Gould (27) and A. Gardner (29), fitters. The firm, it was stated, were engaged on important work. The Chairman said they recognised the importance of the undertaking, but thought that the firm should get ineligible men to do the work. The firm's representative said that the number of

skilled men was limited. If one man was taken it would stop the whole department. Capt. Eve said that if the authorities thought men should be exempted they would be badged. The firm's representative replied that no badges were being issued at the present time. The Tribunal reserved its decision.

At Redruth, the Electric Power Co. appealed for nine members of the staff, eight being tramwaymen. Mr. Hards, for the company, stated that they had lost about 70 men. They had before the war 225 men; now they had about 180. Two of the appeals were refused; the others were each exempted for three months.

Whitstable Tribunal, on November 4th, conceded conditional exemption to Mr. E. C. Spray (40), electrical engineer.

The West Kent Appeal Court, on November 7th, allowed a Military appeal against exemption granted to F. W. Robins, electric wireman, of Bexley, and granted one month's postponement.

At Southowram (Halifax), the case of H. V. Richardson, electrical engineer, in the employ of Messrs. Barraclough Bros., electrical and mechanical engineers, Brighouse, was brought up for review at the request of the Military Representative. Besides being badged, Richardson also held an exemption certificate. It was resolved that the certificate be cancelled, and that he rely upon the badge.

Dorset Tribunal has given conditional exemption, on his obtaining work of national importance, to G. W. Loveless (34), electrician at the Winton Picture Theatre, Poole.

Hereford City Tribunal has given exemption until January 1st, with no leave to further appeal, to Mr. R. E. Walker, electrical contractor.

At Barrow Military Appeal Tribunal, a Special Military Representative objected to a number of exemption certificates which had been granted to men under 30 years of age. Included in the objections were H. Hotchkiss (22) and W. Edmunds (20), in the employ of the Barrow Corporation electricity department. Mr. H. R. Burnett, the borough electrical engineer, contended that both men were essential. He also referred to one of his employés who had been sent back from the Army to work in munition works, where he was not doing as useful work as when he was at Barrow. The Tribunal decided to withdraw the exemption certificates as from January 1st.

At the Scarborough Tribunal, the Military Representative asked that the certificate of conditional exemption granted to a tramway foreman, aged 26, should be withdrawn on the ground that another man in the employ of the company could do the work, and also act as inspector. Temporary exemption was granted until January 1st, but the Tribunal thought the company should try to get another man.

LEGAL.

Crypto Electrical Co. *v.* C. & S. Goodman.

On November 9th, before his Honour Sir W. Lucius Selfe, in the Marylebone County Court, the plaintiffs, of Willesden, sued Messrs. C. & S. Goodman, of the Gem Theatre, Gillingham (Kent), for £30, being the amount of the unpaid due instalments of the price of a hired electric motor.

Mr. R. O. B. Lane, counsel for the plaintiff company, said that in December last the plaintiffs supplied to the defendants an electrical machine on a hire-purchase agreement, the price (£75) to be paid in weekly instalments of 25s. Plaintiffs had previously fitted the Gem Theatre with a three-phase motor of 100 volts, 50 amperes, and the new motor was to be of the same type and power as the former. On December 24th the motor was sent to Gillingham and fixed. A number of small complaints followed as to its efficiency, and these were remedied; it then ran satisfactorily. So far as he (counsel) was aware the machine was, in every respect, quite suitable and as efficient as that already in the defendants' kinema, which had been made and supplied by the plaintiffs. Application had been made for payment of the instalments, but there was no response, and he (counsel) was not aware of any counterclaim being made.

A Witness for the plaintiff said that there was no mention of horse-power in the agreement. They made a general arrangement that the new machine was to be similar to the previous one. When it had been fixed, a suggestion was made that some one should be sent down from the works to adjust it, as "it was not running satisfactorily." Hobbs, the electrician, was sent, and on his return he reported it "all right."

Mr. S. Goodman, for the defence, said that the new machine was of 9½ h.p., and when it was in use it increased the weekly current bill by 15s. He was quite prepared to pay the instalments so soon as the plaintiffs adjusted the machine so that it used no more current than the old one. He held that using more current was not "running satisfactorily."

His Honour: It could not be satisfactory if it was using 15s. a week more current. Can it be adjusted yet?

Mr. Richardson: Certainly it can.

His Honour: And have the same consumption as the first machine?

Mr. Richardson: Exactly. We are quite willing to take the machine back to our works and adjust it.

His Honour: Well, do so. Meantime, there will be judgment for the plaintiffs for £15, and costs.

British Thomson-Houston Co., Ltd., *v.* A. and A. Electrical Co., Ltd.—Infringement of Electric Lamp Patent.

The plaintiffs claimed before Mr. Justice Sargant, in the Chancery Division, on November 9th, an injunction to restrain defendants from infringing their patent for improvements in incandescent lamps. Plaintiffs complained of the sale by the defendants of six half-watt lamps. Mr. A. J. Walter, K.C., with Mr. Colefax, K.C., and other counsel, appeared for the plaintiffs, and the defendants did not appear. The case for the plaintiffs was that their invention gave an efficiency of ·5 watt per c.p., whereas if any previous lamp was run at that efficiency it would be destroyed in a short time; that the filament could be raised to a much higher temperature than was practicable in a vacuum lamp without vaporisation or deterioration or excessive shortening of useful life; that by adopting their invention, lamps could be manufactured to be run at a greater efficiency than anything done before; and that it had resulted in a reduction of the consumption of electricity by more than 50 per cent.

His Lordship granted the injunction, with costs, and made an order for the delivery up of any infringing lamp.

Pembroke Urban District Council *v.* the Diesel Engine Co., Ltd.

According to the *Freeman's Journal*, an application was made before Mr. Justice Kenny, last week, to have a consent made a rule of Court. The Urban Council brought the action against the defendant company for damages for breach of a contract for the supply of a 180-kw. Diesel generator set and fittings at a cost of £2,977. In the course of the trial working of the engine, it proved defective.

Mr. James Lardner, M.P., for the Pembroke Urban Council, moved to make a consent settling the action a rule of Court. The settlement provided that judgment should be entered for the Council for the sum of £1,904 6s., with costs of the action, including costs of discovery; and that on the counterclaim judgment was to be for the Council also, with costs, the amount lodged by the plaintiffs with their defence to be paid out to them.

Mr. Justice Kenny received the consent, and made it a rule of Court.

BUSINESS NOTES.

Australia.—The *Board of Trade Journal* mentions the following inquiries:—A Perth firm desires to obtain agencies in Western Australia for three-phase motors, incandescent electric lamps, and electrical material generally. Another Perth firm wishes to represent British makers of A.C. and D.C. generators, motors and accessories. A third Perth firm desires to represent a British maker of high-class metallic filament lamps.

The Commercial Intelligence Department.—It is announced that an Inter-departmental Committee, presided over by Mr. Harcourt, has now arranged the respective spheres of work and co-operation, in dealing with commercial inquiries, of the new Commercial Intelligence Department of the Board of Trade and the Imperial Institute, which in recent years has become a central department for information and investigation respecting the sources and uses of the raw materials of the Empire. In future, the Technical Information Bureau of the Imperial Institute will answer all commercial inquiries respecting the sources of supply, technical uses, and value of raw materials within the Empire, and will be responsible for supplying all information required in order to bring the producer overseas in touch with the manufacturer at home. Inquiries as to immediate supplies may be addressed either to the Board or to the Institute, as may be most convenient, but the Commercial Intelligence Department of the Board of Trade will, as a rule, be prepared to deal with inquiries for immediate supplies of well-known raw materials which can be obtained at once through ordinary trade channels. In answering those inquiries in which special statistical or trade information is required in addition to technical information, the Board and the Institute have arranged to co-operate. Investigations of the possible industrial uses of raw materials will, as heretofore, be dealt with by the Imperial Institute. The arrangement proposed by the Committee has now been accepted by the Secretary of State for the Colonies, the President of the Board of Trade, and by the Executive Council of the Imperial Institute.

For Sale.—The Leeds Corporation Electricity Department is offering surplus lengths of unused cable for sale. Particulars appear in our advertisement pages to-day.

Trade Within the Empire.—The Council of the Sydney Chamber of Commerce has affirmed the principle that all Government departments, municipalities, and other public bodies spending public money should purchase Empire-made goods, and place all contracts with British firms where possible.—*Tenders.*

A Works Canteen at Leigh.—In the presence of the directors and about 1,000 of the workpeople, a canteen was opened on Tuesday, November 7th, at the Anchor Cable Works, Leigh, by Mrs. James Callender, wife of one of the directors.

Catalogues and Lists.—Messrs. Siemens Bros. & Co., Ltd., Woolwich.—Supplement No. 9 contains a very fully illustrated description of the "Skiafix," an apparatus designed for fixing and holding patients during radioscopy.

Messrs. Simplex Conduits, Ltd., Garrison Lane, Birmingham.—Leaflet No. 644, giving illustrated description and prices of their Universal girder clamp.

Messrs. Wm. Wadsworth & Sons, Ltd., Bolton.—Twenty-four-page attractively illustrated pamphlet showing representative examples of their electric passenger and goods lifts, transporters, jib cranes, &c.

The Sceando Lamp Co., Ltd., 7, Blackfriars Street, Salford, Manchester.—Folder giving prices of their "Sceando" drawn-wire metal lamps, "Axial" lamps, and standard type lamps.

Book Notices.—*The Air Supply to Boiler Rooms.* By R. W. Allen, M.Inst.C.E. From the Author, Queen's Engineering Works, Bedford.—While this work relates specifically to the boiler rooms of modern ships of war, it contains much matter of interest to engineers engaged in other branches of construction. The author deals with the whole of the subject, from the top of the air trunk to the stokehold, and as he has made a special study of the matter, the data which he gives will prove very useful, especially in view of the scarcity of reliable information on problems of ventilation. The book comprises 14 short chapters, giving particulars of the pressure required to set air in motion at given speeds, the air speeds recommended in the trunks, the effect of sudden changes in the area of the air passages, the design of the eye of the fan, inlet rings, and casings, the use of deflectors to prevent interference between adjoining fans, the amount of air required for the combustion of oil fuel, and progress in the design of fans, besides many details relating only to naval practice. Remarkable improvements in efficiency, output, and economy are demonstrated as the results of the application of scientific principles to the subject.

"Scientific Papers of the Bureau of Standards." No. 290. "A Variable Self and Mutual Inductor." No. 292. "International System of Electric and Magnetic Units." Washington: Department of Commerce.

"General Cargo: an Introduction to Salesmanship." By R. E. Goddard. London: Constable & Co. Price 4s. 6d. net.

Italy.—The liberation of the Italian electrical industry from the pre-war dominance of German enterprise has taken an important stride forward by the constitution of the Società Nazionale per Imprese Elettriche—an Italian company formed with 10,000,000 lire capital for the purpose of buying out German participation in Italian undertakings, and notably that of the Siemens-Schuckert group. As an actual fact, the purchase will not be made directly, Siemens-Schuckert, foreseeing the inevitable, having already disposed of their interests to a Swiss consortium. The interest of the German group in the various Italian electrical concerns amounted to some 20,000,000 lire.

Trade Announcements.—Mr. S. T. Jolley has retired from the Diamond Accumulator Co., accumulator manufacturers, of Bournemouth Park Road, Southend-on-Sea, and the business will be continued by Messrs. E. & L. Tickett.

Messrs. T. Reynolds & Co., Ltd., electrical engineers, of Coventry, have removed their showroom premises to over their establishment at 19, High Street.

In connection with the arrangements which British firms are making for extension of business to cope with orders that are likely to mature when the war is over, we have received from Messrs. Creed & Co. particulars of arrangements that have been completed for a general expansion of their business. They have purchased the patents in wireless telegraphy, plant, &c., of the Indo-European Telegraph Co. and the Galletti Wireless Telegraph and Telephone Co. The Indo-European and Telegraph Co. have subscribed for a considerable number of shares in Creed & Co., and two of their directors—Sir William R. Brooke, K.C.I.E., formerly Director-General of Telegraphs of India, and Mr. T. W. Stratford-Andrews, the managing director of the Indo Co., have been elected to the board. Mr. Stratford-Andrews has taken over the managing directorship of Messrs. Creed & Co. Mr. Creed, who is known to all telegraph men, remains chairman of the company, and will advise the board on technical matters. Mr. Donald Murray, whose systems of printing telegraphy are well known, has sold his patents and business to Messrs. Creed & Co., and has joined the board. The company has also secured the services of Mr. H. H. Harrison, whose knowledge of telegraph matters is very extensive. The technical staff of the company has been added to. Amongst others, Mr. Rivers-Moore will devote his services to technical research, and Mr. Morse will look after the wireless side of the undertaking. The company has already started a research department, and there will be showrooms, where specimens of the various apparatus manufactured by the company can be viewed under working conditions. We hear that the Indo-European Co. had already achieved very considerable developments in the design and construction of wireless sets of comparatively low power, and these sets are now undergoing the important process of standardisation.

On November 18th, the offices of both the Worthington Pump Co., Ltd., and James Simpson & Co., Ltd., will be temporarily transferred to Queen's House, Kingsway. This change is due to the fact that the War Office have requisitioned the present offices of the two companies at India House.

LIGHTING AND POWER NOTES.

Accrington.—A resolution was introduced at Accrington Trade and Labour Council, on November 9th, that a protest be made against the financial loss in the electricity undertaking, and urging the need for an expert to be called in to ascertain whether the concern could become a profitable one; and, in the event of the loss being attributable to the geographical position of the electricity works, that immediate steps be taken to have them removed to a more suitable site. Eventually, however, the matter was referred to the Executive Committee for consideration, and it will be brought before the next meeting for discussion. Mr. Emmett (Weavers' Secretary) said a grievance existed, and so far as the weavers were concerned, they were having a lot of trouble. Two mills in the town were run by electricity, and the workpeople were being sent home constantly. Sometimes in one week they had lost nearly half a week's work. The result was that the weavers were demanding compensation at the Weavers' Offices. If a local manufacturer were to blame for this state of things, they would call upon him to remedy it, or the mill would have to be stopped; but they could not go to the electricity department and tell them to stop the concern until everything was made right. It was decided that the Executive should discuss the situation and draft a suitable resolution for the next meeting.

Australia.—The Sydney city electrical engineer has reported, after experimentally using locally-made earthenware pipes in place of the fibre conduit, suggesting that the shipment of fibre conduits on order be proceeded with.

The Electricity Committee recommends that a supply of electricity be given to Messrs. Kilbourn & Willicks, the firm guaranteeing a minimum payment of £260 per annum for five years. With reference to the supply of electricity to the Australian Electric Steel Co., Alexandria, the Committee recommends that the company be permitted to use electricity for auxiliary machinery during the hours in which it is not permitted to use electricity in its furnaces, at the same rate as for the main supply, provided that the maximum demand in K.V.A. of the auxiliary machinery shall not exceed 10 per cent. of the maximum demand in K.V.A. of the furnaces, and subject to the condition that 2 per cent. of the total supply estimated as the energy consumed in prohibited hours be charged at the higher rate of 1½d. per unit. The arrangement to be for a period of six months.

With regard to the report as to the question of providing additional plant at the power house, the Committee recommends that consideration be deferred for six months, but that the specification for the supply of a 12,000-KW. turbo-alternator be approved for use if the same be required.

The Committee recommends that an underground duct system be constructed to connect to the six additional submarine H.T. cables to be laid across Darling Harbour, at a cost of £5,811.

The Committee has considered the question of the rate of hire for electric motors, and strongly recommends that the increased rates remain in force.

The Kandos (N.S.W.) Cement Co. has obtained permission from the Shire Council to install electric lighting in the township.

The Tweed Shire Council (N.S.W.) has decided to borrow £1,300 for the purposes of an electric light distributing system for Tweed Heads.—*Tenders.*

Bettws-y-Coed.—The village was in temporary darkness on Friday evening last, owing to a large eel causing an obstruction in the water-power plant; the water is derived from Elsie Lake, several hundred feet above the works.

Bognor.—Price Increase.—The U.D.C. has received from the Gas Co. an intimation that the charge for electricity will be increased from 6d. to 7d. per unit, with a charge for a minimum number of 20 units per quarter whether consumed or not. The U.D.C. has decided to send a protest to the B. of T.

Bo'ness.—Plant Extension.—The T.C. has agreed to borrow, on the security of the burgh general assessment, £12,000 for the purpose of defraying the capital cost of the extension of the electricity works. The money is to be advanced by the Treasury at 5½ per cent. The loan is repayable in 20 years. The contract price of the extension is £12,300.

Callington.—E.L. Scheme.—The U.D.C. has decided to apply for a L.G.B. inquiry, with reference to the purchase of Frogwell Mills in connection with an electric lighting scheme.

Continental.—France.—In order to conserve for national purposes an adequate supply of gas and electricity, the Prefect of the Police of Paris has from Wednesday, November 15th, forbidden the lighting of shops and stores in Paris, and the Department of the Seine, after 6 p.m. by either gas, electricity, petroleum or spirit, with the exception of grocers', bakers', druggists', and hairdressers', shops which may be lighted as usual. The shops are not compelled to close at six, but if they remain open they must find some other means of illumination.

Norway.—The Commune of Biri, near Lillehammer, has decided to raise a loan of 250,000 kroner for providing an electric lighting service.

The Ormsetfos Kraftaktieselskap is the style of a company formed on October 26th, with a provisional capital of 200,000 kroner, to develop the water power of the Malde River in the Værran district. The water-power station is estimated to cost 2,000,000 kroner.

The Kvina Carbid og Smelteverk is increasing its capital from 760,000 kroner to 1,200,000 kroner, with a view, it is said, to make new departures in the electrochemical industry.

The Aktieselskab Norske Elektrodeverke is a company about to start the manufacture of graphite electrodes, and thus render Norway independent of German imports. It is intended to build a large factory capable of turning out from 1,000 to 8,000 tons. A waterfall in Westland, yielding 10,000-12,000 H.P., has been secured. The minimal capital of the concern is fixed at 1,050,000 kroner, secured by the Norske Credit Bank's guarantee; the maximum capital will be 1,500,000 kroner. It is expected to start working next year.

Epsom.—PRICE INCREASE.—The U.D.C. has fixed the following new scale of charges for energy from December 1st:—Lighting flat rate, 7d. per unit; power and heating, 3½d. per unit.

Halifax.—ANNUAL REPORT.—The review of the year's working of the Corporation departments shows a record of steady progress in the electrical undertaking. The total units sold (13,583,633) was an increase of 2,507,740 on the previous year. The outstanding feature had been the heavy increase in the supply of power for industry. The private lighting supply was much below the normal, due largely to the Daylight Saving Act, and street lighting supply had been practically nil.

Huddersfield.—ANNUAL REPORT.—The departmental reports for the past year show that the electricity department has had a busy year, particularly in meeting large demands for power. The coal supply has given great trouble, and necessitates a further increase in price for energy of 12½ per cent. on pre-war charges, after the current half-year. The three-phase motors connected during the year were equal to 4,050 H.P., bringing the total of three-phase to 12,756 H.P., whilst the single-phase motors connected during the year equalled 95 H.P., bringing the total to 2,723 H.P., a total for both systems of 15,479 H.P. The number of consumers was reported as 6,656.

Ipswich.—YEAR'S WORKING.—The annual report of Mr. Ayton, chief engineer, on the working of the Corporation electricity undertaking during the year ended March 31st last, shows that the units sold advanced from 2,967,000 in 1915 to 3,734,158 last year, the great increase being in power units, while public lighting fell to insignificant proportions. The total revenue amounted to £33,969, while working expenses were £23,030, and after meeting interest and sinking-fund charges, also £1,022 revenue expenditure on capital account, a deficiency of £2,086 resulted. Although the units sold increased by 26 per cent., the cost of coal increased by 84 per cent., to partly counterbalance which the price of energy was raised. The working of the power station was rendered difficult owing to the lack of coal-handling facilities, the provision of which was hindered by the L.G.B., but, owing to the intervention of other authorities, has since been sanctioned. Mr. Ayton draws attention to the high ash content of the coal. 20 to 23 per cent., and suggests that as this uses up railway accommodation and fuel for haulage, the Committee dealing with coal saving might be better employed in looking into the working of collieries rather than adjuring electricity supply undertakings to reduce their consumption by methods which will not produce in practice the result aimed at. Early in the year a turbine broke down, and has had a new set of blades. The report refers to the increasing use of electric vehicles, and the charging facilities provided.

Kirkheaton.—E.L. PROPOSALS.—The B. of T. has intimated its inability to entertain applications from the Huddersfield Corporation and the Electrical Distribution of Yorkshire for an Order for the supply of electricity within the urban district.

Leeds.—PROSPECTIVE EXPENDITURE.—In reply to an inquiry from the L.G.B. as to the execution of works after the war, the electricity department estimated that there would be an urgent need for the expenditure of £418,000 and the tramway department of £150,000.

London.—The L.C.C. Finance Committee recommends the sanction of the Council to the borrowing of £4,236 by the Poplar B.C., for electricity mains.

The Metropolitan Asylums Board has agreed to a 10 per cent. increase in the charge for electricity supplied by the South Metropolitan Electric Tramways and Lighting Co. to the Queen Mary's Hospital and the Downs Sanatorium.

The L.C.C. has entered into a fresh agreement with the Erith U.D.C. for the supply of electricity to the Southern Outfall Sewage Works.

New Zealand.—As a result of a poll of the ratepayers of the Borough of Pukekohe (North Island), it has been decided to borrow the sum of £12,000 for, amongst other purposes, the installation of electric lighting in the borough.—*Board of Trade Journal.*

Newport (Mon.).—YEAR'S WORKING.—The annual report on the Corporation electricity undertaking for the year ended March 31st last shows that the receipts amounted to £51,275 and the working expenditure to £30,339, leaving a gross profit of £20,935, which was rather less than the previous year's figure, £21,607. Allowing for accrued interest, &c., and deducting interest and sinking-fund charges, war allowances for two years, and other items, there remained a deficit of £993, as against a profit of £744 in 1914-15. The energy sold for all purposes amounted to 5,015,074 units, as compared with 4,789,240 units in 1914-15. The maximum load was 2,961 KW. and the load factor 26·3 per cent.; 4½ lb. of coal were used per unit generated. During the year a breakdown occurred with the 3,000-KW. turbo-alternator plant; the Mill Parade substation was temporarily completed, and the new rotary converter plant put into operation. A steady increase has occurred in the demand for heating and cooking purposes, which it is expected will exceed one million units during the current year, at 1d. per unit plus 20 per cent. Very little benefit was derived from the large factories which have been connected up during the period under review.

PLANT EXTENSION.—The borough electrical engineer has been instructed to prepare a specification and invite tenders for additional plant at Mill Parade sub-station; also to dispose of a 150-KW. motor. As a result of a conference between the Chief Constable and the borough engineers, the street lighting has now been extended.

Southend.—WAR BONUS.—All male employés at the electricity works who have been in the service of the Corporation for 12 months, are to be granted a war bonus of 2s. a week, commencing November 23rd; employés already receiving a war bonus are to have the sum named as an addition.

Sheffield.—NEW GENERATING STATION.—The City Council has adopted the recommendations of the Electric Light Committee to erect a new generating station, and has agreed upon a site. The present Neepsend plant is unable to meet the demand.

Wadebridge.—PUBLIC LIGHTING.—The Electric Supply Co. having received an application for current from Clapper, has asked the U.D.C. whether, if the extension is made, the public lighting will be extended to the locality after the war. The Council has replied that at present it is not in a position to give a definite reply.

Walsall.—Owing to the second turbo-alternator for the new generating station having been requisitioned, it will be necessary to keep the Wolverhampton Street station fully manned and running until a second set is installed at Birchills. The Corporation will in due course make a claim in respect of the loss sustained by reason of the commandeering of the second turbo-alternator.

TRAMWAY and RAILWAY NOTES.

Accrington.—ELECTRIC VEHICLE.—The General Purposes Committee has considered a proposal from the Health Commissioners to purchase an electrically-driven wagon, at a cost of about £1,000, for the collection of the refuse of the borough. It is claimed that a motor-wagon will effect a saving of 10 per cent. to 15 per cent. compared with the hire of team labour at the present price.

Continental.—FRANCE. — According to the *Financial Times*, a movement has been started in France for the creation of a great trans-European railroad to link up the Atlantic coast of France with Italy and South Russia. The line will commence at Bordeaux, and pass through Lyons, Turin, Milan, Venice, Trieste, Fiume and Agram to the banks of the Danube, traversing Serbia and Roumania, and terminating at Odessa. It will be 2,500 km. in length, and will closely cling to the southern slope of the great mountain ranges of Europe. The numerous waterfalls and the character of the country will admit of the line being electrified throughout its entire length. The line will link up Switzerland directly with the French Atlantic seaboard, and greatly facilitate trade between Italy and the West of France; for this reason the Italian Government is said to favour the scheme, and the Swiss are keenly alive to the advantages of the French section, as it would enable them to link up Switzerland and Swiss products directly with Bordeaux, Nantes, La Pallice, and other Atlantic seaports.

Halifax.—YEAR'S WORKING.—Reviewing the year's work of the various Corporation departments, the Mayor of Halifax, on re-election, said the income during the year on the tramways had been £112,937, an increase on the previous year of £1,145. There had been a satisfactory net surplus, which had enabled them to give £6,240 to the relief of rates. The car-mileage had been 2,195,980, and the number of passengers carried 21,024,003, the latter an increase over the figure of 20,707,071 last year. The revenue from the motor-'buses was £2,430, or 9·252d. per 'bus per mile. There were now 88 women conductors on the system.

Huddersfield.—TRAFFIC STATISTICS.—The departmental reports for the past year show that the total receipts on the tramways from November 1st, 1915, to September 30th, 1916, amounted to £136,612, an increase on the corresponding period of the previous year of £12,325. The town's tramway track within and without the borough now covers 56 miles, and further extensions have been prevented by the war. The car-mileage, including the running of coal trucks, was 2,611,967, an increase of 25,754, and the number of passengers carried was 26,328,482, an increase of 2,899,229. The total number of employés of the department now on military service is 160, and there are now 65 women conductors.

Glasgow.—At the first meeting of the T.C., a finding of the Tramways Committee will be considered, asking that all female employés in the tramway department work under the same terms and conditions and be paid on the same scale of wages as the male employés.

Ipswich.—Year's Working.—The annual report on the working of the Corporation's tramway shows a total revenue amounting to £28,287; working expenses amounted to £19,179, war service allowances to £587, and, after meeting interest and loan repayments, there was a profit on the year of £2,757, which compares with a loss of £2,105 in the previous year. The passengers carried numbered 6,798,589, and the car-miles 620,115, which compare with 5,610,332 passengers and 642,092 car-miles in 1915. The reserve, or renewals fund, now amounts to £19,970. Mr. Ayton, the manager, refers at some length to repairs and maintenance; much of the track requires renewal, and in one section the subsoil will require drainage. When the time comes for relaying the line in Norwich Road the question of abandoning the distant section running into Whitton should be considered, this having always involved a dead loss; the same applies also to Burrell Road and Bath Street. If the war lasts long, Mr. Ayton suggests that rails in these streets should be taken up for repairing busy routes.

Leeds.—Wages.—The overhead equipment staff of the city tramways have been granted increases of wages from a ½d. to a ½d. per hour, with overtime at the rate of time-and-a-quarter.

London.—Wages.—The Highways Committee of the L.C.C. has received an application from the women employed at the central car repair depôt for an increase of wages of 6s. per week. The Committee has decided that an increase of ½d. per hour, or 2s. per week, should be made to those women over 21 years of age; this has been declined, with a request that the matter be referred to the appropriate Conciliation Board. The Committee recommends that the advance of ½d. an hour be approved, the question of a further advance to be referred to the Conciliation Board. The war bonus of 3s. per week to car examiners and car washers is to be increased by 1s. per week, as from March 1st last.

Newport (Mon.).—Year's Working.—During the year ended March 31st last, the Corporation tramways carried 10,017,515 passengers and ran 921,133 car-miles, these figures comparing with 9,410,109 passengers and 964,895 car-miles in the previous year. The total income amounted to £45,141, and the working expenses to £30,461, leaving a gross profit of £14,680, as against £11,748 in the previous year. After meeting interest and sinking fund charges, &c., there remained a net profit of £5,409, as compared with £2,417 in 1914-15.

A serious street car accident on the Stow Hill route, due to a collision, was the subject of a report by the electrical engineer. He said there was little doubt that the collision was occasioned through the absent-mindedness of the motor-man, also to the fact that the slipper-brakes on his car were not down in accordance with regulations. Although there were no serious casualties except to the motor-man, who had both his legs broken, the cost of repairs will be heavy. Arising out of the collision the electrical engineer had given consideration to the question of improving the present arrangement of the track, so as to prevent, if possible, a similar accident, or reduce the possibility of serious consequences.

Northenden.—A year's extension of time for completing the tramways in this parish has been applied for by Manchester T.C.

Stockton.—The T.C. has appointed a Sub-Committee to inquire with regard to the power of the Corporation under the various Acts relating to the Imperial Tramways Co. for tramways in the borough.

Stretford.—The clerk has been instructed to communicate with the Manchester and Salford Corporation tramways department, with a view to effecting an improvement in the Trafford Park service during the busy evening hours. During the past month 112,936 units were sold for traction purposes, as compared with 100,278 units in the corresponding month of the previous year.

Walsall.—The Tramways Committee has under consideration a memorial from the Workmen's Union asking for an advance of ½d. an hour. In order to deal more satisfactorily with the question of missed fares, instructions have been given that the fares of all passengers who propose to travel on the top deck shall be paid to the conductor when the passenger boards a car.

TELEGRAPH and TELEPHONE NOTES.

Africa.—There is now direct communication across French and British territory in Africa, with posts on the Atlantic and Indian Oceans. The French authorities in the region of Lake Tchad are contemplating the establishment of regular communication between Egypt, the Red Sea, Cameroon, and Nigeria.—*The Times.*

Cable Telegraphy.—A new invention, devised by Mr. Thomas B. Dixon, has been in practical operation on certain of the Atlantic cables, and is reported to have given remarkable results, the speed of operation in the commercial handling of cable messages having been increased upwards of 125 per cent., while in tests far greater speeds have been attained. The gain in speed is due to the use of selenium cells to amplify the signals received, and to the use of means for obtaining, from one or more sources of illumination, a very large number of light beams, concentrated coincidently upon selenium cells, and deflected by a line galvanometer across the surfaces of the selenium cells, the effect being that a very intense illumination of the selenium cells is obtained. It is found that the practicable speed of operation increases as the intensity of illumination increases. The selenium cells operate a siphon recorder or a relay. There being no physical connection between the recorder or relay and the line galvanometer, the inertia and frictional losses present in the older magnifying and recording apparatus are largely eliminated, the more so as in the new system the amplitude of vibration of the galvanometer coil is, in general, much less than in the case of the older apparatus.

It is stated that Mr. Dixon employed 45 separate light beams, all derived from one 400-c.p. tungsten lamp, and all concentrated on a thin galvanometer mirror 5 in. long and ⅛ in. wide. These light beams were reflected from the galvanometer mirror, in one case, a distance of 7½ ft., and were then re-reflected a further distance of 7½ ft. to the selenium cells, the light beams being concentrated coincidently upon the cells.

With this apparatus, working over one of the trans-Atlantic cables, the normal rate of operation of which is less than 200 letters per minute, speeds of 450 letters per minute and higher were obtained in the regular commercial handling of business, and still higher speeds have been obtained on test, with signals fully readable as to size and character.

An interesting feature of the invention is a new balancing arrangement, which greatly facilitates the obtaining of a balance on the cable for duplex working, and also aids materially in shaping the signals so as to render them readable.—*T. and T. Age.*

Pacific Cable.—The report of the Pacific Cable Board for the year 1915-16 shows that the total revenue was £310,516, and the expenditure £205,896, leaving a surplus, after allocating £74,000 to the renewal account, of £104,620; of this sum, £77,545 was paid to interest and sinking fund, and £9,150 to the renewal fund as interest and sinking fund in respect of money borrowed from the renewal fund for the Auckland-Sydney cable, leaving a surplus of £17,925, which goes to reduce the debt. The excess of receipts over expenditure was £25,934 greater than in the previous year, and this is the first occasion on which there has remained a surplus from revenue after payment of the sinking-fund annuities. The net traffic receipts were up by £88,749. The expenditure included special appropriations to the renewal account of £30,000 in respect of depreciation of securities and £14,000 in payment for a new schooner; after deducting these items, there is an increase of £15,537 over the preceding year, due to various causes arising out of the war. The renewal fund on March 31st, 1916, stood at £271,460. The section Norfolk Island—Auckland was interrupted on February 12th, owing to a fault near the island; it was repaired on February 19th, traffic in the meantime being diverted to the Southport—Norfolk cable. All the cables have been worked continuously at high pressure, the long sections carrying far more traffic than was originally expected; they are now occupied day and night throughout the week.

During the year, nearly 8¼ million paying words were transmitted over the cable, much more than double the traffic during the last normal year (1913-14). There was also a considerable quantity of non-paying matter. The Board also carried nearly two million paying words between Australia, New Zealand, and the Pacific Isles. The deferred traffic was more than doubled, and the week-end traffic more than trebled, as compared with the previous year, but ordinary traffic decreased 30 per cent., owing to the restricted use of codes. The cheap services had to be suspended on certain occasions owing to interruptions in the Atlantic cables and congestion of traffic, and the outward week-end and deferred Press services are at present in abeyance, but will be reinstated as soon as possible.

The Board has established a public office for international business in Melbourne. A new schooner is being built, in place of the *Strathcona*, to maintain a boat service with Fanning Island. Sir George H. Reid, having retired from the position of High Commissioner for the Commonwealth, has been succeeded on the Board by Mr. Andrew Fisher.

South-Western Railway Electrification.—The electrification of the Claygate Branch has been completed, and a half-hourly service of electric trains between Claygate and Waterloo, covering the journey in 29 minutes, is announced to commence on Monday.

Telephone Charges.—According to the *Times*, the Post Office Telephone Department is abolishing all unremunerative rates, which are the result of telephone competition in the past, and the intention is to have one fixed charge in every place.

The Marconi Co. and Germany.—A letter has been circulated to the Press by Marconi's Wireless Telegraph Co., Ltd., with regard to an attempt which, it is said, is being made to create uneasiness in the minds of the public in respect of the relationship which has existed between the Marconi Co. and the German Telefunken Co.

Mr. Godfrey Isaacs, managing director, states that the Belgian company to which reference has been made was formed in the year 1901, and secured from the Marconi Co. the mercantile marine rights of certain countries in Europe, including those of Germany and Austria. The company was purely Belgian, and the shares were held in Belgium and England. The Belgian company pro-

ceeded to install and operate apparatus on all the principal ships of the mercantile marines of Germany and Austria, but in the year 1910 the German Government made it known that they would no longer sanction the installation or operation of any wireless system on board any German ships other than the German system, under German control. In these circumstances, the Belgian company was threatened with a considerable loss; it, therefore, came to an agreement with the German Telefunken Co. for the formation of a company in Germany, the Belgian company, together with the Marconi Co., retaining a 45 per cent. interest in the German company, while the Germans held 55 per cent. The Belgian company and the Marconi Co. appointed members on the board of the new German company. Subsequently the Austrian Government took a similar action, and the Belgian company thereupon agreed with the German company that the Austrian ship stations should be transferred to the German company. In return, however, it was agreed with the German company that their sphere of action should be strictly limited to ships of Germany and Austria.

The Belgian company was reconstructed and the capital divided, the Belgians holding one-third, the Marconi Co. one-third, and the Germans one-third.

At the outbreak of war, two Germans in the employ of the Belgian company were immediately dismissed. The business of the Belgian company was promptly taken in hand by the English directors and transferred to Marconi House, and has been under the complete control of the English directors ever since.

With regard to Australia, owing to the Australian and New Zealand Governments having placed large contracts in the hands of the Germans for the construction of powerful coastal wireless stations, the Germans were in a position of considerable advantage. The Marconi Co. commenced proceedings for infringements of patents against the German company and the Australian Government, but subsequently a settlement was arrived at with the Germans, under which it was agreed that an Australian company should be formed, which should purchase the interests both of the Marconi Co. and of the German Telefunken Co. This company had a capital of £140,000, of which the Marconi Co. held one-half, the Australians some £62,000, and the Germans about £8,000. Thus a complete control of wireless in Australia passed into Australian and English hands.

With regard to other countries, the nature of the agreement was purely commercial, and was brought about as a result of the strength of the Marconi Co.'s patent position. It served to prevent the German company ousting the Marconi Co. from every country in the world by reason of the ruinous prices which the German company was quoting at no matter what financial loss, no doubt with the German Government behind it, for the purpose of obtaining German wireless stations throughout the world. Under such conditions it was impossible for the Marconi Co. to compete. It is only in consequence of this agreement that British wireless stations now preponderate throughout the world.

Whilst the Marconi Co. was interested in the German company, and had directors on the German company's board, the English Marconi Co. has never had any German director upon its board, nor has the German company at any time held any interest in the English company.

On Wednesday questions were asked in the House of Commons with regard to the agreement, and Mr. Pease undertook to inquire into the matter.

Trans-Pacific Wireless.—Yesterday the Japanese Government and the Marconi Wireless Telegraph Co. of America inaugurated a commercial wireless service between California, Honolulu, and Japan.

CONTRACTS OPEN and CLOSED.

OPEN.

Argentina.—November 30th. Buenos Aires Municipality. Electric carbons required during 1917. Oficina de Licitaciones, Intendencia Municipal de la Capital, Avenida de Mayo, 525, Buenos Aires.

Australia.—SYDNEY.—January 3rd. N.S.W. Railways and Tramways Department. 50-ton electric overhead travelling crane for Yarra Street power-house, Newcastle.*

January 8th. Municipal Council Electric Lighting Department. 33,000-volt switchgear. E.L. Department, Town Hall. Specification 10s. 6d.*

January 22nd. Electrical plant (converter, battery, booster, and switchboards) for the Castlereagh Street sub-station, for the Municipal Council. Specification from E.L. Department, Town Hall.*

MELBOURNE.—December 11th. City Council. Supply and erection of coal transporter plant. See "Official Notices" September 15th.

Cape Town.—January 5th. Electric motors and starting panels, for the Corporation Electricity Department. Dock Road, Cape Town.*

Durban.—January 3rd. Corporation. One 3,000-KW. steam turbine, alternator, and condensing plant. Specification No. S. 238; drawing No. P. 597, both at the office of the Borough Electrical Engineer, Municipal Buildings. Deposit £2 2s.

Enniskillen.—December 1st. Sligo, Leitrim & Northern Counties Railway Co. Twelve months' supply of telegraph materials. Mr. J. Duff, Secretary to the Company.

Grenada.—December 31st. Government. Electric supply at St. George's and suburbs. Tenders to Colonial Secretary, Grenada, British West Indies.

Johannesburg.—November 20th. Corporation. 500 or 1,000 trolley wheels for tramcars (Contract No. 181).*

November 27th. Corporation. 1,000 sets of single-pole, ironclad house-service cut-outs (Contract No. 187); 250 field coils for tramcar motors (Contract No. 192).*

December 9th. Corporation. 1,427 A.C. and D.C. electricity meters and 100 time-switches. Specification (21s. deposit) from Mr. E. T. Price, General Manager's Office, Electricity Supply and Tramways Department, President Street, Johannesburg, W.*

December 20th. Corporation. Automatic pressure regulators for the A.C. turbo-generators at the power station.*

January 3rd. Corporation. Iron axles and bushes.*

London.—H.M. OFFICE OF WORKS.—November 27th. Twelve months' supply of electric cable and wire. See "Official Notices" to-day.

Liverpool.—November 22nd. Cheshire Lines Committee. General stores, including (6) telegraph materials and carbons, during 1917. Stores Superintendent, Warrington.

Newcastle-on-Tyne.—November 23rd. The Tyne Improvement Commissioners. Six and twelve months' supply of incandescent lamps, and arc lamp carbons. Commissioners' Offices, Berwick Street.

New Zealand.—DUNEDIN.—January 24th, 1917. Motor-generator, accessories and spares. City Electrical Engineer, Market Street, Dunedin.*

Rhondda Valley.—November 20th. Electrical installation in screwed tubing for Messrs. David John & Co., brewers, Pentre. See "Official Notices" November 10th.

Sheffield.—November 21st. Cast-iron pipes and forming valve chamber. November 17th.—Reinforced concrete carrying bridge over G.C. railway at Neepsend power station.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Department in London.

CLOSED.

Australia.—P.M.G.'s Department, N.S.W.:—

Telephone equipment in connection with the installation of an automatic private branch exchange at Cockatoo Island, £1,813.—Automatic Telephones (Australasia), Ltd.

One accumulator battery, 2,500 amp.-hours capacity, for Sydney City Exchange, £358.—T. K. Steanes.

P.M.G.'s Department, Queensland:—

One power board, £152.—Edison Swan Electric Co., Ltd.

300 accumulators, 80 amp.-hours capacity, £518.—Warburton, Franki, Ltd.

Victoria Railway Department:—

Incandescent electric lamps for 12 months.—Edison Swan Electric Co., Ltd.
—*Tenders.*

Impregnating electrical apparatus with insulating varnishes, spare parts, &c., £2,234.—Gibson, Battle & Co., Ltd.
—*Aust. Mining Standard.*

The Electricity Committee of the Sydney City Council has recommended that, in connection with the contract with Standard Waygood-Hercules, Ltd., for the supply of consumers' meters, a payment of 75 per cent. of the price of the meters in England as they are shipped be agreed to.—*Tenders.*

Bradford.—The B. of G. has accepted the tender of Messrs. Smith & Croft, at £26, to provide a cable for the lighting of the laundry and garage.

London.—L.C.C.—Asylums and Mental Deficiency Committee. Electric lamps for five months: Pope's Electric Lamp Co., Ltd.

METROPOLITAN ASYLUMS BOARD.—Accepted tenders:—

Lund Bros. & Co.—Rearrangement of electric lighting, Mead Station, £42; wiring Eastern, North-Western, Western, and Brook Stations, £65.

Crypto Electrical Co.—Four electric motors, Eastern, North-Western, Western, and Brook Stations, £40.

MARYLEBONE.—Electricity Committee:—

Cables (contract extended for a further six months to March 31st, 1917).—B.I. & Helsby Cables, Ltd.

The Committee recommends the acceptance of the offer of the British Westinghouse E. & M. Co., Ltd., to supply a balancing attachment for a rotary converter, at £165.

Sheffield.—Town Council. Electricity Department. Accepted tenders:—

A. Reyrolle & Co., Ltd.—20 panels H.T. two-phase sub-station switchgear, £2,700.

Staveley Coal & Iron Co., Ltd.—10,000 3-in. cast-iron cable pipes, £7 10s. a ton.

Tramways Department:—

Dawson & Jones, Ltd.—Alterations and additions to Town Head Street Depôt, to convert it into a motor-bus garage, £3,619.

West Bromwich.—T.C. Coal for the electricity works T. Boston & Sons; W. H. Bowater, Ltd. Field & Bradley.

FORTHCOMING EVENTS.

Institution of Mechanical Engineers.—Friday, November 17th. At 6 p.m. At the Institution of Civil Engineers, Great George Street, S.W. Report of the Hardness Tests, Research Committee.

Association of Mining and Electrical Engineers (Notts and Derbyshire Branch).—Saturday, November 18th. At 3.30 p.m. At the University College, Nottingham. Paper on "Some Electrical Troubles and their Remedies," by Mr. T. Anderson.

Electro-Harmonic Society.—Monday, November 20th. At 8 p.m. At the Holborn Restaurant (King's Hall). Ladies' night.

Institution of Civil Engineers.—Tuesday, November 21st. At 5.30 p.m. Paper on "Keady Bridge," by Mr. J. B. Ball.

Royal Society of Arts.—Wednesday, November 22nd. At 4.30 p.m. At John Street, Adelphi, W.C. Paper on "The Economic Development of Russia and Britain's Share therein," by Mr. Leslie Urquhart.

Institution of Electrical Engineers.—Thursday, November 23rd. At 8 p.m. At Victoria Embankment, W.C. Paper on "The Parallel Operation of Electric Power Stations," by Mr. J. S. Peck.

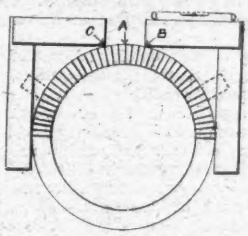
Greenock Electrical Society.—Thursday, November 23rd. Visit to Overton Paper Mills. Members to meet at 7.30 p.m.

Physical Society of London.—Friday, November 24th. At 5 p.m. At the Imperial College of Science, South Kensington, S.W. Ordinary meeting.

NOTES.

General Accessories Co., Ltd. — CORRECTION. — The name of the company mentioned in our last issue under "Liquidations" was incorrectly given, owing to the omission of the word "Engineering." The meeting of creditors held at 120, Blackfriars Road, S.E., on November 7th, was of General Engineering Accessories, Ltd., whose winding-up was announced in the ELECTRICAL REVIEW for November 3rd, page 489. The General Accessories Co., Ltd., of Worship Street, E.C., makers of electrical accessories, are in no way connected with the matter. We regret the error.

Car-motor Defects.—The following experiment with the brush gear of a tramcar motor has proved successful in saving endless trouble:—90 per cent. of switch-blowing on tramcars is due to the brush gear either not being in its proper position, or being spaced out wrongly; this was a great trouble on the cars under the supervision of Mr. E. Mercer, of Castleford, until he adjusted all the brushes to their proper positions. The diagram shows a simple method of finding out the brush positions: Place



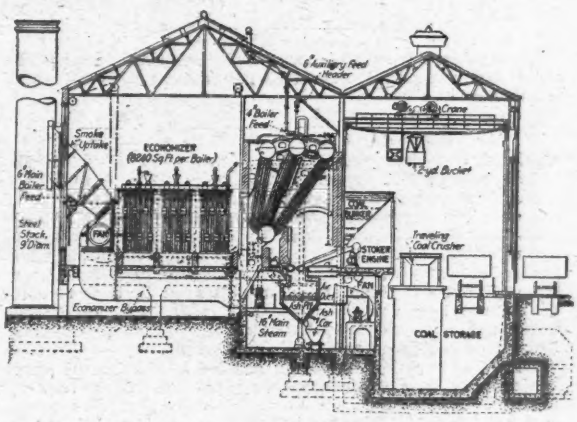
an ordinary steel square in the position shown in the diagram, with a level on top; see that the square is touching both side and top of commutator. Adjust the square until the level is reading correctly, then mark the commutator at the end B of the square; then place the square at the other side of the commutator, and mark the commutator at C. Find the centre A between C and B, and count equal numbers of bars down both sides to set the brushes.

A Fact.—A joiner employed by a northern electricity supply department in fitting-up a cupboard over an electricity meter, &c., in a small shop, had put a small porcelain insulator to act as a door-knob; when the foreman came round to inspect the job he was told by the shopkeeper that he would not have that ———y incubator in his shop.

Development of the Turbine.—At a meeting of the Newcastle-on-Tyne Chamber of Commerce, Mr. Gerald Stoney proposed that the Chamber should draw the attention of the Engineering Committee of the Advisory Council of the Privy Council for Scientific and Industrial Research to the importance of a full and complete research into the methods by which the steam turbine could be improved in efficiency and reliability. In view of the success of the steam turbine in the mercantile marine, and its probable larger adoption in the future, this was of the greatest importance to the shipping industry. Mr. Stoney had not been able to get the exact expenditure on coal used on merchant ships, but had received various estimates ranging from £30,000,000 to £60,000,000 a year as the value of the coal. If they took 5 per cent. of that as the saving that might be effected by the development of the turbine, it would amount to from £1,500,000 to £3,000,000. Thus the sum of £10,000 to £15,000 which might be spent on research would be a mere bagatelle. The cost of fuel used on land amounted to about £50,000,000 a year, so that they would see that a saving of 5 per cent. effected there would amount to a very large sum annually. The use of turbine engines was rapidly increasing at sea. Up to the present they had been chiefly used for war vessels and passenger steamers, but now they were coming into use for tramp steamers, and in that connection he mentioned that Messrs. Cairns & Noble, Newcastle, had built the first large tramp turbine steamer on the Tyne. The firm was, he understood, very well satisfied with the venture. The motion was carried unanimously.

Novel American Coal-Handling Plant.—A recent issue of *Power* described the plant extension of the West Penn Traction Co., of Connellsville, Penn. Three new independent water-tube boilers, each of 13,719 sq. ft. heating surface, and each equipped with a 14-retort underfeed stoker, and provided with an 8,240-sq. ft. economiser and independent stack, are installed. The boilers are built for a working pressure of 250 lb. per sq. in., and will supply steam, superheated 100-120°, to an 18,000-KW. turbine unit. The boilers are of the Stirling type, with three upper drums and one lower drum; they are set higher than usual to provide a large combustion space, and the baffling is of the four-pass type. The grate gives a ratio of 54·2 sq. ft. of boiler heating surface per sq. ft. of grate area. The coal displaced by each stoker piston movement is 18 lb., and the stoker can handle 16,000 lb. of coal per hour. A forced-draught fan of 60,000 cb. ft. per min. capacity against 6-in. w.g. pressure supplies air to each furnace, and an induced-draught fan discharges the economiser gases into the 100-ft. stack.

The ash-pits are under the combustion-chambers, and discharge



into cars hauled by an electric locomotive, the ashes being dumped into a 320-ton storage pit at the end of the boiler house.

There are no overhead coal bunkers; railway cars are run into the boiler house, on a track passing along the boiler fronts, *beneath which is a 2,100-ton coal storage pit extending the full length of the boiler room.*

Spanning this portion of the building is an electrical travelling crane with a 2-cb. yd. bucket, which delivers fuel to the stoker-hoppers, either direct from the railway car, or from the pit. *Each of the stoker-hoppers has a capacity of 55 tons.* If run-of-mine coal is received, it is unloaded by the crane into a travelling crusher (capacity 100 tons an hour, with a 15-ton hopper), and then hoisted to the stoker-hoppers. The crane also travels over the ash storage pit and hoists the ashes into empty railway cars for removal.

The crane (on which, it will be seen, the operation of the plant depends) is equipped with a 25-H.P. lifting motor, a 35-H.P. motor for opening and closing the bucket, a 5-H.P. trolley motor and a 25-H.P. bridge motor, and has a hoisting speed of 150 ft. per min. The crane is equipped with a recording and weighing scale. The design and erection of the plant were carried out by Messrs. Sargent and Lundy, of Chicago.

Electricity on a Duck Farm.—At the Tanglewood Ranch, near New York, 20,000 to 25,000 ducks are raised each year for table use.

Hatching continues from January 1st for eight or nine weeks, and the electric incubator plant in use has a capacity of 9,600 eggs, the incubation period being one month. The incubator lamps are run on a 10-volt circuit operated through a transformer from the 110-volt general lighting circuit. Central station energy at 2,200 volts, 60 cycles, is received and transformed down to 110 or 220 volts at suitable points. Three 30-watt tungsten searchlights are located so as to illuminate the area occupied by the fully-grown ducks, and all can be operated from the owner's house, superintendent's house, or watchman's house; they serve as a burglar alarm and to prevent panic at night.

In addition, 60-watt lamps on brackets are distributed over the farm, and the dwelling and brooder houses are electrically lighted.

The use of electric power has effected a considerable reduction in expense over the ordinary source of energy—a petrol engine. Ten thousand ducks of all ages require a variety of food, and many meals a day. About 20 bushels of green stuff are cut up twice a day and mixed by machinery with other food, such as meal, the mixer being in fairly constant use.

Three pumping plants are installed, one being driven by a windmill.

New Primary Cell.—It is reported in the *Western Morning News* that Mr. W. Skinner, a member of the mechanical staff of that journal, has invented a new primary battery, which is claimed to be cheaper to manufacture and maintain than any other, absolutely immune from polarisation, free from local action, and of very low internal resistance. The kathode consists of carbon impregnated with a substance to which hydrogen cannot adhere, and is somewhat analogous in its action to the platinised silver kathode of the Smee element. The anode is of zinc, and the electrolyte consists of a strong solution of common salt and water, one pint of which will keep a miniature lamp glowing for 40 hours continuously before the solution needs renewing. The cell has an E.M.F. of 1·2 volts.

Institution and Lecture Notes.—University College, London.—In his third lecture on "Long-Distance Telephony" on Friday last, Prof. J. A. Fleming continued the discussion of the formulæ relating to the transmission of electric waves through cables. The expansion $\cosh(\alpha l + j\beta l) = \cosh \alpha l \cos \beta l + j \sinh \alpha l \sin \beta l$ (which was incorrectly printed in our last issue) can be simplified if αl is greater than 3, as then $\cosh \alpha l$ is practically equal to $\sinh \alpha l$; therefore $\cosh \mathrm{P}\, l = \sinh \mathrm{P}\, l$, and substituting we get—

$$V_1 = V_2 \cosh \mathrm{P}\, l \,.\, (Z_r + Z)/Z_r$$
$$I_1 = I_2 \cosh \mathrm{P}\, l \,.\, (Z_r + Z)/Z,$$
$$\text{and } \epsilon^{\mathrm{P}\, l} = 2 \cosh \mathrm{P}\, l.$$

In a long cable with voltage V_1 at the sending end, the voltage V at a distance l is $V = V_1 \epsilon^{-\mathrm{P}\, l} = V_1/(2 \cosh \mathrm{P}\, l)$; and with terminal apparatus of impedance Z_r at l, the voltage at the end V_2, from the foregoing equation (if $\alpha l > 3$) is found to be—

$$V_2 = \frac{V_1}{2 \cosh \mathrm{P}\, l} \cdot \frac{2 Z_r}{Z_r + Z}$$

and

$$I_2 = \frac{I_1}{2 \cosh \mathrm{P}\, l} \cdot \frac{2 Z}{Z_r + Z}.$$

If two cables of characteristics Z and Z^1 are joined together, the second may be regarded as a receiving instrument of impedance Z^1, and we have—

$$V_2 = \frac{V_1}{2 \cosh \mathrm{P}\, l} \cdot \frac{2 Z^1}{Z^1 + Z} = \frac{V_1}{2 \cosh \mathrm{P}\, l} \left(1 + \frac{Z^1 - Z}{Z^1 + Z}\right)$$

which shows that part of the wave is reflected at the junction, represented by the fraction $(Z^1 - Z)/(Z^1 + Z)$ of the incident wave, while the remainder passes on; this ratio is called the coefficient of reflection, while the ratio $2 Z^1/(Z^1 + Z)$ is known as the coefficient of transmision, the phenomena, as demonstrated by the lecturer, being analogous to those exhibited by light waves passing through a transparent body. Owing to the occurrence of these reflections, the interposition of underground cables in circuit with overhead lines produces a great increase in the attenuation, and is highly detrimental to the transmission; it is of the utmost importance to keep the Z of the line unchanged.

The effect of an impedance coil inserted in a line was shown to be similar to that of a change in the character of the line at a junction, and this fact made Heaviside's proposal to insert inductance appear undesirable; but in 1913 Pupin discovered that if the coils were spaced at short intervals compared with the wave-length, the reflection losses would be negligible. The necessary condition was that $\theta/2$ should not differ sensibly from $\sin \theta/2$, where $\theta = 2\pi d/\lambda$, λ being the wave-length and d the interval between successive coils. The "loading" increases the wave constant β and diminishes the attenuation constant α. In practice the loading coils are double wound on circular cores of very fine iron wire, the coils being inserted in the go-and-return leads in such a way as to assist one another in magnetising the ring; the ratio of effective resistance to inductance is as small as from 50 to 25, and the coils are inserted at intervals of d miles such that C L d does not exceed 25; where C is the capacity of the line in microfarads per mile and L the inductance of the coil in millihenrys. Various examples of such coils were shown, and the methods of installing them on O.H. and U.G. Post Office lines were illustrated, heavy loading requiring, say, 250 M H. at 1¾-mile intervals, and light loading, say, 50 M H. at 2½-mile intervals, on an underground cable, while in aerial lines the coils were spaced about 8 to 12 miles apart. The physical aspect of the subject was illustrated with an apparatus devised by Dr. Fleming, showing stationary waves in rotating cords, unloaded and loaded, with beads representing the coils. In calculating the characteristics of loaded lines, as a first approximation, the inductance is assumed to be uniformly distributed. When this method does not give results sufficiently accurate, a special formula is employed. Where it is necessary to change the character of the line, the inductance must be tapered off, to prevent a sudden change of impedance.

Institution of Civil Engineers.—In the course of his inaugural address last week, the president, Sir Maurice Fitzmaurice, touched upon the subject of the training of engineers. He himself had been brought up on compulsory Latin and Greek to the age of 19, both languages being taught in such a way as to develop the minimum amount of interest in his mind; on the other hand, he was taught mathematics and experimental science by a man whose teaching was alive, and who made commonplace things interesting—one could not help learning from him. He wished to draw attention to the fact that, whatever educational programme might be devised, a great deal depended on the teachers. While he was extremely keen on a radical alteration in our teaching, so that scientific education should be kept all the time in the foreground, he insisted on the importance of a good general education, and suggested that a knowledge of one or more modern languages should be made obligatory. In addition to technical training, experience on works was indispensable—preferably on large works—and the capacity of "getting on" with people and still holding one's own was of very great value. After some years' work at home, a young engineer should spend a few years abroad.

Dealing with the necessity of improved relations between employers and workmen after the war, which can only be brought about by increasing our trade, the president remarked that it would be well if the Institution gave more consideration to questions of industrial and commercial policy, with which many of the members were well fitted to deal. The speech of the Prime Minister on August 2nd could only mean that the whole power of the Government would be placed at the disposal of our trade, and that the Empire would be united for purposes of peace as well as for war. Still greater weight attached to the spirit which at present animates our commercial leaders. Sir Maurice expressed the hope that those who were dealing with the development of our foreign trade would not fail to include full consideration of the important question of the adoption of the metric system of weights and measures in this country. This system was obligatory in 34 countries, with a population of 437 millions, and the Government of the United States had issued a report this year, in which it was stated that international business required international weights and measures.

Institution of Electrical Engineers.—On Thursday, last week, the opening meeting of the session was held. Premiums awarded for papers were presented, and Dr. A. Russell delivered the Kelvin Lecture, which is abstracted elsewhere in this issue.

The opening meeting of the MANCHESTER LOCAL SECTION was held on Tuesday last, when the Chairman, Mr. A. E. McKenzie, read his inaugural address, dealing with the organisation of engineering industries, the linking-up of power stations, the Summer Time Act, and various other matters.

The first ordinary meeting of the session of the SCOTTISH LOCAL SECTION was held at Glasgow on Tuesday last, when the inaugural address was given by the chairman (Mr. J. K. Stothert), who spoke particularly of the position of the industry after the war in reference to the educational and apprenticeship problems. It was expected that Mr. C. P. Sparks, President I.E.E., would be present, but it was intimated that on the previous morning Mr. Sparks had sustained an accident in London, which had prevented him from travelling North.

The meeting of February 16th will be held at Glasgow, not Edinburgh, as stated in our last issue.

The first meeting of the NEWCASTLE-ON-TYNE LOCAL SECTION was held at Newcastle on the 13th inst., when Mr. H. W. Clothier, the new chairman, delivered his inaugural address. Before commencing his address, he announced that the Section was forming a roll of those members who were serving their King and country either in the Navy or the Army, and it was the Committee's intention to send, with the members' approval, a letter of encouragement to each stating "that the opening meeting of the Session resolved that an expression of goodwill be sent to members on active service at home and abroad, wishing them God-speed and a safe return." This was agreed to, on the motion of Mr. P. V. Hunter.

The Faraday Society.—"Refractory Materials" were discussed at the meeting last week. Sir Robert Hadfield, F.R.S., the president, stated that the subject had not received in this country the attention it should have had. There had been considerable importations from abroad of refractories, when, without doubt, equally good material was available in our own country. Much research was required in addition to that which was carried on at the works of the manufacturers.

The Royal Society.—The Council has awarded the Copley Medal to Sir James Dewar, F.R.S., for his researches on the liquefaction of gases; the Rumford Medal to Prof. W. H. Bragg, F.R.S., for his researches in X-ray radiation; the Davy Medal to Prof. H. L. le Chatelier for his researches in chemistry; and the Hughes Medal to Prof. Elihu Thomson for his researches in experimental electricity. The Council recommends that Sir J. J. Thomson be elected president at the anniversary meeting on November 30th.

Electrical Association of Australia.—At a meeting held in Melbourne, on September 28th, Mr. F. W. Chambers read a paper on "Scales of Charges in Relation to Electric Supply," and Mr. J. H. Butters one on "A Description of the Tasmanian Government Hydro-electric Scheme."

South African Society of Civil Engineers.—At a meeting held in Cape Town in September, a paper by Prof. H. Bohle, entitled "Small Electric Power Stations; with Special Reference to the Worcester Hydro-Electric Scheme," was read. Prof. Bohle remarked that in that country municipalities were separated by great distances, and a supply in bulk was out of the question, except in a few isolated cases. Wherever electric light was desired, a power station had to be erected, resulting in a somewhat large capital expenditure per KW. installed, and, consequently, a high charge for energy sold. By carefully designing the plant, it was usually possible to keep the working costs within such limits that the cost per unit sold for lighting purposes did not exceed 1s. maximum. The author went on to describe the principal features of the plant erected for the Worcester Municipality, which had cost approximately £15,000. The total annual costs would amount to about £2,400, so that an average income of £200 per month would be required to make ends meet. Of this sum £55 per month would result from street lighting, leaving an amount of £145 per month from private consumers. The system had not been officially opened many weeks, and the income had already reached the required sum. At Stellenbosch, a town somewhat similar to Worcester, the scheme cost only £10,900. The figures for the first year showed working costs amounting to £488, the income being from public lighting £500, and from private consumers £1,688. The whole profit made during the first year had been put to depreciation and sinking fund. The figures showed that, with judicious working, even a small power station might be made a very profitable undertaking.

Copper Prices.—THE WEEK'S CHANGES.—Messrs. F. Smith & Co. report, Wednesday, November 15th:—Electrolytic bars rose from £144 10s. to £147 10s.; ditto sheets, from £162 10s. to £165 10s.; ditto rods, from £153 10s. to £156 10s.; ditto H.C. wire, from 1s. 6½d. to 1s. 6¾d.; silicium bronze wire, from 1s. 9¼d. to 1s. 10d.

Messrs. James & Shakespeare report, Wednesday, November 15th:—No change in prices quoted last week.

The Nobel Prizes.—The Academy of Science has decided to reserve the sums appointed for the physics and chemistry prizes for a future occasion.

Manchester Engineering Wages Advance.—According to the Manchester *Daily Despatch*, time workers in the engineering and allied trades in South-East Lancashire and Manchester are to receive an advance of 3s. per week. The decision was announced by the Committee on Production, which has been investigating the men's application for an advance of 9s. per week. The new concession, which is not intended to apply to or to affect piece prices, is to be regarded as war wages, and recognised as due and dependent upon the existence of the abnormal conditions now prevailing in consequence of the war. Engineering workers in Manchester, Ashton-under-Lyne, Newton-le-Willows, Stockport and Warrington are affected. The men were given 3s. advance some time ago, so that a large number are now receiving 6s. per week more than in pre-war times.

Dublin Electricity Supply.—Mr. W. M. Murphy, chairman of the Dublin United (Electric) Tramways Co., who has been the keenest critic of the management of the Dublin electricity concern, has, in an interview, denied a statement attributed to Mr. L. Sherlock, ex-Lord Mayor, and ex-chairman of the Electricity Committee, that he opposed the obtaining of the money necessary "for providing what Mr. D'Alton now regards as absolutely necessary."

"What I did oppose, at the inquiry in 1911, when the Corporation were seeking sanction for a large sum to extend the buildings and plant at the Pigeon House, was," said Mr. Murphy, "the spending of money on the Pigeon House site—'the mistake of great magnitude,' as Mr. D'Alton calls it—and time has fully justified the advice I tendered. I had then absolutely no interest except that of the ratepayers and electric current consumers, being the largest representative ratepayer in Dublin, and I was at the time contributing to the Electric Department one-fortieth of their whole income from private consumers. The Corporation, however, chose to treat me as a hostile witness, and would have none of my advice, as it did not fit in with their pet scheme.

"My intervention did not consist of mere criticism. I brought them an offer from the owners of an ideal site for a generating station on the quays which could be indefinitely extended, and I showed them how the new plant could be erected there, and how such of the Pigeon House plant as was worth retaining could be transferred to the new site."

In Mr. Murphy's opinion, "the excuses for not making the business pay are simply childish." "A monopoly of the electric supply of Dublin could," he declared, "be a magnificent property and a valuable concession; but I do not think that any solvent man or company could be found to-day who would take a present of the undertaking with an obligation to discharge its liabilities."

Educational.—UNIVERSITY OF BRISTOL "SANDWICH" SCHEME.—Dr. Wertheimer, the Dean of the Faculty of Engineering of the University of Bristol, has proposed a modified "sandwich" system of training for engineering students. A student on leaving school will enter the University, and will spend a session there, passing the intermediate examination for the B.Sc. Degree in Engineering at the end; if his record is good and he is a promising student, he will be recommended to a firm, which will allow him to enter its works for a period of 14 months. This will enable the student to judge to what extent he is fitted for an engineering career, and will also enable the manufacturers to form an impression as to his suitability. He will then return to the University for a further period of two years, in some cases spending the Long Vacation in the works; after that he will return to the same works, if he has given satisfaction, for another period of 14 months. A number of firms have already agreed to take part in the experiment, including the Electric Construction Co., Ltd., Wolverhampton; Messrs. R. A. Lister & Co., Ltd., Dursley; and Messrs. Mather & Platt, Ltd., Manchester.—*The Times.*

The BOARD OF EDUCATION last year announced its intention to discontinue lower general examinations in Science and Technology, but in a circular recently issued states that it hopes to be able to hold the higher general examinations in 1917, in accordance with the regulations and syllabuses which governed the conduct of those examinations in 1915 and 1916. After 1917 no higher general examinations will be held in Pure Mathematics, Theoretical Mechanics, Heat, Magnetism and Electricity, Organic Chemistry, Coal Mining and Metallurgy.

Lundberg "Batch Exams."—As the present war time is not very suitable for embarking on one of their periodical switching competitions, Messrs. Lundberg & Sons have hit upon the idea of "batch exams." This means that anyone applying for particulars of the next competition is given the opportunity of working an examination paper without delay, and that when a certain number of such papers is in hand, the batch is examined, and certificates are awarded to those who acquit themselves well. The results of the first of these batch exams. are as follows, the names in each grade appearing in order of merit:—

Advanced.—H. Hanks (Birmingham); T. C. Hodges (London); S. Frankland (E. Morton, Yorks.); L. Thomas (Rugby); T. Doyle (London); H. Cunnick (Swansea); J. W. Hiron (London).

Intermediate.—H. Grimshaw (Golborne, Lancs.); W. A. McCall (Blackburn); W. E. Fairchild (Newark); C. R. Gunn (Liverpool); R. Maynard (Clesthorpes); J. J. Rogers (Dundalk); K. G. Ferguson (London); A. Holroyd (Port Clarence).

Preliminary.—A. Doyle (Bexhill); J. Moran (Storling, near Bury); "Winnie" (London); C. G. Ovens (Manchester); P. Carroll (Drumcondra); J. C. Gale (Eastbourne); C. H. Bull (Blaina, Mon.) *Extra.*—A. V. Harris (Waltair, India).

Information concerning the above exams. can be obtained on writing to the firm at 477-489, Liverpool Road, London, N. Those who are interested in the subject may be reminded that we published a set of simple problems relating thereto in our issue of the 3rd inst.

Dublin Fire Incident.—While engaged in the extinction of a fire which had broken out in a furniture store at Harrington Street, Dublin, a member of the City Fire Brigade got in contact with a live electric wire, and seized hold of a colleague who was near by. Both men received severe shocks, and fell from the first window of the building to the street. They were subsequently attended to in the Meath Hospital.

Signalling with Bare Wires.—The West of Scotland Branch of the Association of Mining Electrical Engineers, which is in January next holding a display of all the various types of bells that comply with the recent report on electric signalling with bare wires, is inviting manufacturers who desire to exhibit, to get into touch with the secretary. An announcement on the subject appears in our advertisement pages to-day.

Heating Appliances.—On October 15th, the licence schedule of prices on heating appliances under the Marsh patent for nickel-chromium resistance elements went into effect in the United States. The Marsh patent is owned jointly by the Hoskins Manufacturing Co. and the General Electric Co., and almost all of the responsible heating-appliance manufacturers have been granted licences under the patent. Under the terms of the licence each appliance carries a minimum list-price and a maximum discount. The manufacturer, however, may charge a price higher than schedule, which is being done on some lines.—*Electrical World.*

Volunteer Notes.—FIRST LONDON ENGINEER VOLUNTEERS.—Headquarters, Chester House, Eccleston Place.—Orders for the week by Lieut.-Col. C. B. Clay, V.D., Commanding.

Monday, November 20th.—Technical for Platoon No. 9, at Regency Street. Squad and Platoon Drill, Platoon No. 10. Signalling Class. Recruits' Drill, 6.25—8. Lecture, "On Telephones," 7.30.

Tuesday, November 21st.—School of Arms, 6—7. Lecture, 7.15, "Squad and Platoon Drill," Company Commander Fleming.

Wednesday, November 22nd.—Instructional Class, 6.15. Platoon Drill, Platoon No. 2.

Thursday, November 23rd.—Platoon Drill, Platoon No. 7. Ambulance Class by M.O., 6.

Friday, November 24th.—Technical for Platoon No. 10, Regency Street. Squad and Platoon Drill, No. 9. Signalling Class. Recruits' Drill, 6.25—8.25. Lecture, "On Telephones," 7.30.

Saturday, November 25th.—Parade, 2.20. Uniform, for inspection by the County Commandant, at 3. As a full muster is important, every member should attend.

Sunday, November 26th.—Entrenching at Otford.—Parade Victoria (S.E. & C. Railway Booking-office), 8.45 a.m.

(By order) MACLEOD YEARSLEY, *Adjutant.*

November 19th, 1916.

Appointments Vacant.—Charge engineers for the Northern Command power station. See our advertisement pages to-day.

Large British-Built Pelton Wheel.—On Wednesday last we were able to inspect a large Pelton wheel which has recently been constructed in this country by Messrs. James Gordon & Co., the well-known water-power engineers, for the extension of the British Aluminium Co.'s hydro-electric plant in Scotland. The wheel will develop a maximum output of 3,300 B.H.P. at 300 R.P.M., and is, therefore, far larger than anything of the kind previously attempted in the country, and, indeed is, in point of comparative size, a very large wheel. The plant, which we hope to describe in an early issue, is equipped with special governing gear, and is intended to drive a three-phase generator.

Electric Steel Furnaces Worked from Town Supplies.—A writer in a French journal suggests the installation of electric furnaces in towns, in order to utilise the plant lying idle at the power station during slack times. He saw the first installation of this kind about eight years ago in a suburb of Turin. There were two small Stassano furnaces of 100 H.P. each, and two of 1,000 H.P. each, taking their current direct from the town supply. In France the idea is making headway. Outside Limoges, a Keller furnace has just been installed, capable of melting down 30 tons of iron turnings and other cheap scrap per day, and producing 25 tons of high-priced cast metal, in conjunction with dephosphorisation or without it, or turning out ordinary cast-iron of high quality when the current is obtainable at a low rate. The furnace occupies a very small space in the tramway depôt, and requires little attendance owing to the provision of ample labour-saving appliances. The current in this case is transmitted from a hydraulic power station to Limoges at 30,000 volts, where it is transformed down to 10,000, and then again to 110 volts to suit the furnace. The consumpton of energy is about 700 to 800 KW.-hours per metric ton of metal produced. The first heat would, it is presumed, have to start about midnight, or soon after the peak-load was passed at the power-station.—*Colliery Guardian.*

U.S. Census of Electrical Manufactures.—A preliminary statement on the manufacture of electrical machinery, apparatus, and supplies, for the year 1914, compared with the year 1909, has been issued by the Bureau of the Census. The summary shows that the capital employed in 1914 was $355,725,000, an increase of 32·8 per cent. as compared with 1909, and the value of the products was $335,170,000, an increase of 51·4 per cent.—*T. and T. Age.*

Colliers and Flash Lamps.—A collier at Cwmcarn was fined 20s. for having in his pocket whilst in the pit an electric flash lamp. He had procured the lamp in order to guide him on his way to the pit in the dark mornings; and it was stated that he flashed his lamp on his way out of the colliery. The prosecuting solicitor pointed out that it was distinctly provided in the Act that no apparatus for producing a light should be employed underground except a safety lamp of approved pattern; and the management of the colliery took a serious view of this offence, desiring to stop this sort of thing at the beginning.—*Colliery Guardian.*

Accumulator Manufacture in America.—The equipment of the new works of the Willard Storage Battery Co., which are approaching completion near Cleveland, U.S.A., will include apparatus using alternating current at 24,000 volts, for the testing of battery jars, by means of which the smallest holes or thin spots can be detected. Incorporated in the new factory is also a refrigerating test-room, in which it will be possible to test motor-car engines fitted with electric starting and car-lighting motor-generators, battery, &c., at low temperatures. The engine unit with the starting and lighting equipment will be mounted on a trolley, which runs on a track into the refrigerating room, where a temperature of 20° F. below zero can be maintained. Arrangements are provided for controlling the engine from the outside, and by this means it will be possible to check the behaviour of the batteries used with the engine-starting and car-lighting sets under extremely low temperature conditions.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—Mr. G. B. HALLAM, shift engineer at the Hackney electricity works, who met with a severe 'bus accident in January last, has now resumed his duties after being detained in hospital for ten months. Before returning to work he led to the altar Miss Tuffle, of Sunderland.

The Marylebone B.C. Electricity Committee recommends the Council to grant leave of absence during the period of the war to Mr. H. H. HOLMES, sales manager, who has been offered an appointment in the Army with a commission.

Mr. T. K. RICHARDSON, station superintendent at the Marylebone electricity works, has resigned his position owing to failing health.

General.—Mr. W. H. ALLEN, who relinquished the position of borough electrical engineer at Loughborough in August last, joined Messrs. Chance & Hunt, Ltd., at Oldbury, in an advisory capacity for the whole of their works at Oldbury and in various other parts of the country. The reason for Mr. Allen's appointment was the recognition by the firm of the need, in their particular business, of an engineer to give the whole of his attention in the first instance to the application of current in all possible ways to chemical production, and secondly, to generate power on a high annual load factor at the lowest possible cost, as electrolytic methods of production result in much greater purity.

Mr. CHRISTOPHER YOUNG, formerly of the electrical staff of the Farnham Gas & Electricity Co., who joined the Royal Flying Corps, and who recently obtained his "wings," has been married to Miss Phyllis Lake.

Ald. G. WEEKS, of Messrs. Weeks & Son, electrical engineers, has been re-appointed Deputy-Mayor of Bromley (Kent).

London Gazette Notice.—Territorial Force. Royal Engineers. Tyne Electrical Engineers: Lieutenant (temporary Captain) C. M. Campbell to be temporary Major.

The undermentioned Second-Lieutenants (temporary Lieutenants) to be temporary Captains:—

H. O. Rogerson; H. Sherlock; C. F. Scott; D. Myles; F. B. C. Sutthery; T. T. Tucker; W. H. James; J. Lawther; R. H. Rooksby.

The undermentioned Second-Lieutenants to be temporary Lieutenants:—

H. G. Campbell; E. V. Baldwin; E. Harrison; O. W. E. Hedley; W. W. Wilson; C. B. S. Micklam; W. Fox; J. B. Murray; C. Graham; J. L. Batey; D. E. Ross; A. S. Burdis; J. R. T. Emerson; F. T. Hamilton.

Mr. W. NEWTON WESTON, M.I.Mech.E., has been appointed a director of Messrs. Herbert Morris, Ltd., of Loughborough. He will continue to hold the position of secretary, which he has occupied for the past nine years.

Roll of Honour.—The West Ham Corporation tramway traffic staff have presented an inscribed silver tea service to Regimental-Sergeant-Major J. R. JONES, Royal Welsh Fusiliers (London Welsh), who enlisted whilst a motorman, in commemoration of his bravery in action by which he gained the Military Cross.

Sapper (Corporal) A. J. TOWLSON (London Field Company) has been presented with the Military Medal for executing a most important survey successfully under heavy fire. Sapper Towlson was a draughtsman in the employ of the India-Rubber Co., Silvertown, and he has been on service in France for two years.

Corporal BASIL O. DAWTREY DAWSON, Canadian Battalion, who was for several years a pupil at the Corporation electric light works at Folkestone, has fallen in action.

Sergeant L. PAYNE, R.E. (Signalling Section), who has been awarded the D.C.M. for gallantry on the field of action, was a Leeds tramcar driver. Gunner H. LONG, R.F.A., who has earned the Military Medal for excellent work as a signaller, was a Leeds tramcar conductor.

Corporal ALAN WALKER, West Yorkshires, who is reported killed in action, was an electrician in the employ of Mr. R. Falshaw, of Harrogate.

Private JOHN SMITH, West Yorkshire Regiment (Machine Gun Section), who has been awarded the Military Medal, was employed at the Leeds Corporation electricity works.

Gunner W. RILEY, R.F.A., employed in the Manchester Corporation tramways department, has been awarded the Military Medal.

Sergeant J. W. WOOD, 4th London Field Ambulance, R.A.M.C. (an employé of the Marylebone electricity department), has been awarded the D.C.M.

Private T. A. JONES, of Runcorn, who has won the V.C., was previous to the war in the employ of the Mersey Power Co., Ltd., as fitter in the power station at Weston Point. Single-handed, he captured 102 Germans. He is 36 years of age. The local Press contains copies of many messages of congratulation, and his native place has naturally duly celebrated his magnificent exploit.

The sudden death at the Wimereux Hospital of Private ROBERT DONALDSON, Royal Irish Rifles, who was assistant electrical engineer to the Corporation of Halifax, is reported.

Second-Lieutenant J. R. IRELAND, Argyle and Sutherland Highlanders, killed in action, was 19 years of age, and was a student in mechanical and electrical engineering at Edinburgh.

Private REID, H.L.I., killed in action at the age of 22 years, was employed as an electrician with Messrs. Allan Arthur and Ure, Glasgow.

Sergeant W. D. BARRON, Canadians, has been missing since October 8th. He was employed with the Winnipeg Electric Car Co., and was 26 years of age.

Private W. E. DUNN, 11th Hants. Regiment, who has fallen in action, was employed in the Burton Corporation electricity department.

Sergeant F. J. BURK, who prior to enlistment was employed at the Accrington electricity works, has won the D.C.M.

The Military Medal has been awarded to Lance-Sergeant BERT MEE, of the West Yorkshire Regiment, who joined the Forces when only 16. Formerly he was in the tramways department at Bradford.

Corporal J. THOMPSON, East Kent Regiment, formerly driller, permanent-way section, of the L.C.C. tramways department, has been killed in action.

Private W. HAZELDINE, East Lancashire Regiment, who enlisted whilst with Messrs. Bullers, Ltd., Hanley, has died of wounds.

Private J. GOODWIN, Leicestershire Regiment, killed in action, was an electrical engineer formerly engaged at Belton Park, Grantham.

Second-Lieutenant A. JACKSON, Border Regiment, killed in action on November 3rd, aged 25, was an electrical engineer with the British Westinghouse Co., Ltd.

Gunner J. HENDERSON, R.F.A., who served his apprenticeship with Mr. J. Ellwood, electrician, of Whitehaven, has died of beri-beri whilst on service in Mesopotamia.

Lance-Corporal E. RICHARDSON, East Kent Regiment (The Buffs), who is reported from France to be missing since October 7th last, was for 14 years on the staff of the Maidstone Corporation electricity works.

Company-Sergeant-Major HERBERT SALTER, Rifle Brigade, who was at the outbreak of war an electrician at Manchester, has fallen in action, aged 34 years.

Private LEONARD ROWLEY, Royal Fusiliers, who has been killed in action, was on the staff of the Potteries Electric Traction Co.

Private HARRY THOMPSON, York and Lancaster Regiment, of the Rotherham Corporation tramway staff, has been awarded the Military Medal.

The Military Cross has been awarded to Lieutenant H. B. BARRAN, R.F.A., and Second-Lieutenant S. R. BUTLER, R.F.A., for laying telephone wires under heavy fire, &c., at the end of September. Military Medals have been won, also for specially hazardous telephone work, by Gunner A. DRIVER, R.F.A., Acting Bombardier C. E. BRAYSHAW, R.F.A., and Private C. TWINEHAM, West Yorks.

Obituary.—SIR W. VAUGHAN MORGAN.—We regret to record the death, which occurred on Sunday in his 86th year, of Sir Walter Vaughan Morgan, who many years ago, together with five of his brothers, founded the Morgan Crucible Works, at Battersea, and established two now well-known trade papers—*The Ironmonger* and *The Chemist and Druggist.*

MR. S. W. MADDICK.—We regret to announce the death, which occurred on November 5th, of Mr. S. W. Maddick (retired), late electrical engineer, H.M.O. Works, at the age of 72. Mr. Maddick's name has been identified with electrical engineering since its infancy. He became associated with the Heating, Ventilating and Lighting Department at the Houses of Parliament as far back as 1869.

NEW COMPANIES REGISTERED.

Traction Development, Ltd. (145,238).—This company was registered on November 6th, with a capital of £30,000 in £1 shares (10,000 7½ per cent. pref. ord.), to carry on the business of manufacturers of locomotives, traction engines, motor cars, aeroplanes, and all heavier-than-air flying machines, and fittings for the same, mechanical and electrical engineers, &c., and to adopt an agreement with R. F. Macfie and Macfie & Co., Ltd. The subscribers (with one pref. ord. share each) are: A. Smeed Prall, 49, Swanage Road, Wandsworth, S.W., solicitor; H. N. Letts, 106, Fernhead Road, Maida Hill, W., solicitor's clerk. Private company. The number of directors is not to be less than two or more than five; the first are F. Macfie, 40, Talbot Road, W., and H. F. Smalman-Smith, Hampden House, Kingsway, W.C. Qualification, one share. Remuneration as fixed by the company. Solicitors: Corbould, Ellis & Mitchell, 3, Church Court, Clement's Lane, E.C. Registered office: Hampden House, Kingsway, W.C.

Tele-Dis Services (Founders' Company), Ltd. (145,270).—This company was registered on November 9th, with a capital of £1,000 in 1,000 founders' shares of £1 each, to acquire and turn to account any invention for improvements in hygienic appliances relating to telephone apparatus, sound-recording instruments, &c., and to carry on the business of manufacturers of and dealers in hygienic apparatus, lotions, polishes, pastes, patent medicines, and chemicals of all kinds, &c. The subscribers (with one share each) are: Millicent Roberts, 74, Sussex Street, Poplar, E., clerk; V. F. Mepham, 197, Felsham Road, Putney, S.W., accountant. Private company. The number of directors is not to be less than two or more than seven; the first are not named. Solicitor: W. A. Colyer, 1, Clement's Inn, Strand, W.C. Secretary: W. S. Smee. Registered office: 97, Queen Victoria Street, E.C.

General Engineering & Export Co., Ltd. (145,240).—This company was registered on November 7th, with a capital of £5,000 in £1 shares, to carry on the business of general merchants, engineers, contractors, brokers, commission agents, manufacturers of mechanical and electrical plant, machinery, and hardware, &c. The subscribers (with one share each) are: W. C. Gurney, 112, Chestnut Avenue, Walthamstow, clerk; A. T. Freeman, 20, Marquis Road, Stroud Green, N., publisher's assistant. Private company. The number of directors is not to be less than two or more than five; the subscribers are to appoint the first. Solicitor: C. Crowther, 23, Abingdon Street, S.W. Registered by Jordan & Sons, Ltd., 116-17, Chancery Lane, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Rangoon Electric Tramway & Supply Co., Ltd.—A memorandum of satisfaction to the extent of £5,750 on February 2nd, 1916, and to the extent of £826 on October 4th, 1916, of deb. stock dated February 1st, 1906, December 22nd, 1908, and November 5th, 1913, securing £250,000, has been filed.

A. Hirst & Son, Ltd.—A memorandum of satisfaction in full on September 7th, 1916, of debs. dated February 11th, 1910, securing £3,600, has been filed.

CITY NOTES.

Drake & Gorham, Ltd.

Mr. Bernard Drake presided at the annual meeting, held on November 9th. He said that the net profit of £8,527 compared with £3,817 in the previous year, and considering the proportion of their men who were with the Forces, the shortage of country-house installations, and the allowances they were making to absentees, they had been able to very satisfactorily adjust their organisation to meet the altered conditions. Government contracts included work on a number of camps in all parts of the country, and work for various branches of the Services, as well as at the works of big engineering, shipbuilding, and other companies. The large electric generating station for the United Alkali Co. had been satisfactorily put to work, and he had every hope that when the results were ascertained it would lead to further work of the same character. The speaker gave the names of important works at which power and lighting installations had been carried out, also of eminent private clients. The factory had done well, and very great credit was due to the works manager, who had increased his output by nearly 75 per cent. The wholesale department, the operations of which were naturally curtailed by the lighting restrictions and cessation of building work, had been able to apply its energies to the execution of Government power and lighting orders, &c., with the result that both the turnover and profits had increased considerably during the twelve months. Every effort was being made to organise this and other departments with a view to trade after the war, as they looked forward to receiving export orders in connection with the reconstruction work which would be necessary in Belgium, France, Russia, and elsewhere. Their electric vehicle department had been able to demonstrate on an extended scale the economy and convenience which could be obtained from electric haulage. Vehicles had been supplied to the Chester Corporation, the Manchester Corporation, Broughton Copper Co., Ford Motor Co., Brunner Mond & Co., Deakins, Ltd., J. & J. M. Worrall, Ltd., Ainsworth & Son, and others. They had also repeat orders from Messrs. Richard Johnson and Nephew, Messrs. Greenall, Whitley & Co., and Messrs. Levinstein, Ltd. As Edison batteries were reported to have run over 60,000 miles in this country without renewals it was clear that battery-propelled vehicles would play an important part in the world's carrying trade. As he was compelled last year to refer to the disappointing results of the branch in Manchester, he was pleased this year to congratulate the staff on the improvement which they had been able to show both in turnover and profit. As regards the future, there might well be hard times ahead, and the Labour problem was very acute, but they had made a good start for the current year, and although it was unfortunate that it had been found necessary by heavy taxation to curtail trade extensions, and consequently earning capacity in the near future, they might rest assured that they would all do their best to meet whatever difficulties might be in store for them.

The Edison Swan Electric Co., Ltd.

The report for the year ended June 30th, 1916, states that after providing for interest on both classes of debenture stock, and depreciation upon freehold properties and plant there is a net profit of £24,147, plus £4,879 brought forward. The directors propose to transfer to reserve account £25,000, carrying forward £4,025. The capital expenditure during the year, before providing for depreciation, has amounted approximately to £16,000, the major portion of this having been expended upon additional plant and machinery. The company's trade has shown a further considerable improvement during the year. In consequence of this expansion all available cash is required in the business, and considerable further sums could have been profitably employed. Under these circumstances, the directors regret that they are not in a position to recommend the payment of a dividend upon the shares. The high cost of labour and materials has again seriously affected the profits derived from the manufacture and sale of drawn-wire lamps, it being impracticable to increase the selling price of these to meet such extra cost. The engineering side of the works has been almost wholly employed upon special work. The export business shows a still further expansion, and this branch of the company's trade being now established upon a firm basis, it is hoped that when normal times come still better results will be obtained. Annual meeting: November 22nd.

Monte Video Telephone Co., Ltd.

After providing for all charges in Monte Video and London, and making provision for income-tax and excess profits duty, the net profit for the year ended July 31st, 1916, was £25,985, as against £25,776 for the previous year. £8,000 is put to depreciation of property and plant, £9,000 is transferred to reserve for renewals, and after paying a final dividend of 2½ per cent. on the preference and one of 3 per cent. on the ordinary, making 5 per cent. on the preference and 6 per cent. on the ordinary for the year, £5,694 is to be carried forward, as against £5,394 brought in. There has been a moderate increase in the number of subscribers. Owing to pressure of business engagements Mr. L. Phillips has retired from the board, and his brother, Lord St. Davids, has been elected to fill the vacancy. Mr. Albert Anns, formerly secretary of the National Telephone Co., Ltd., is recommended as an additional director.

Western Telegraph Co., Ltd.

Sir J. Wolfe Barry, presiding at the meeting last week, said that although the receipts from messages were less by somewhat over £15,000, the interest from investments, &c., almost balanced this amount, resulting in a net decrease of slightly over £1,000 in revenue. In 1914-15 the message revenue was the highest in the history of the company. Not only were a smaller number of messages transmitted, but a larger proportion of the total were "deferred" at half rates. The net profit to the company was less than for the previous year, but an unusually large balance of nearly £86,000 was brought forward from June 30th, 1915, and in view of the satisfactory condition of the company's financial position the directors felt justified in recommending the payment of a bonus of 2 per cent., instead of the 1 per cent. paid in past years, making a total distribution of 8 per cent. for the year, free of income-tax. With regard to the revenue since June 30th last, the traffic receipts for the three months to the end of September showed scarcely any variation as compared with the corresponding period last year.

Fraser & Chalmers, Ltd.

For the year to June 30th the profit, after providing for all expenses and depreciation on buildings, plant and machinery, was £24,668, as compared with £12,058 for the previous year. This profit has been arrived at after making provision for war taxation. The results show a considerable increase over those of the previous year, notwithstanding the increase in the cost of labour and materials, the difficulty of maintaining a sufficient labour force, and also the large increase in rates of freight and insurance to South Africa and elsewhere. The merchandise business in South Africa has shown substantial improvement during the year, and the prospects for the current year there, as well as at the other branches of the company, are good. The dividend of 7½ per cent. on the preference shares was paid in July last. The directors have decided to carry forward the balance of profit to the current year in order to conserve the resources of the company required to provide for the large increase in values of stocks and work in progress.

British Uralite (1908), Ltd.—For the year ended June, 1916, the profit was £6,308. After paying 5 per cent. dividend, and putting £2,000 to reserve, £1,197 is carried forward. The outstanding debentures, which participated in the profits, have now been paid off.

Yates & Thom, Ltd.—The directors announce that, in consequence of an adjustment not having been arrived at with the authorities in respect of the proportion of profits payable to the revenue, it is impossible at the present time to issue a correct balance sheet for the year ended August 12th. The directors, however, feel justified in recommending a 10 per cent. dividend on the ordinary shares.—*Financial Times.*

Cleveland Trust, Ltd.—At the annual meeting, held at Middlesbrough last week, Mr. W. H. Hustler, who presided, said the Trust had been very severely hit by the holding of land and the electric light undertaking at Saltburn-by-the-Sea. In regard to the latter, he was afraid there was no possibility of any improvement so long as the lighting restrictions and the greatly increased cost of oil fuel lasted, but, so far, the directors had not thought it advisable to meet the position by increasing the price of current to consumers in the special circumstances obtaining at Saltburn. They had confidence, though, that the undertaking would give them a fair return as soon as the restrictions were removed.

Cape Electric Tramways, Ltd.—A dividend of 3¾ per cent., less tax, is announced.

R. Hornsby & Sons, Ltd.—Dividends, 6½ per cent. and a bonus of 3¾ per cent. on the ordinary shares are recommended, carrying forward £43,754.

Castner-Kellner Alkali Co., Ltd.—A dividend of 13 per cent. for the past six months makes a total of 22 per cent. for the year.

STOCKS AND SHARES.

Tuesday Evening.

Markets round the Stock Exchange exhibit a very fair amount of steadiness, and the firm manner in which Consols and other gilt-edged issues are maintained is a useful buttress to other investment securities. Here and there some slight yielding is taking place, though this does not become noticeable until a would-be seller tries to realise his stock, when both he and his stockbroker may be surprised to find that the transaction is less facile than they expected to find it. This is more particularly the case with stocks in such markets as those touched upon here, because in a large majority of the stocks and shares the market is at the best of times somewhat limited. To-day, the position is that in many cases dealing has become a matter of negotiation.

The reasons are several-fold, and have been alluded to on various occasions here. Summed up, they embrace the advent of a new Loan, the disappointment over Roumania, and the modification of the undue optimism which saw, last July, a termination to the war by the end of the present year. But the fine news of this week has helped to cheer up things generally.

Amongst electricity supply shares, a dullish tone prevails. It is not that there is much stock on offer, but rather the absence of inquiring buyers, that gives the market a heavy tendency. City Lights have been lowered ½, and so have Metropolitans and London Electric preference, the last-named looking reasonably-priced on a basis of 6¼ per cent. return. But with Exchequer Bonds paying 6, an industrial preference—even allowing for its being irredeemable—fails to attract at less than 7 per cent., unless it boasts special reasons to make it tempting.

The re-election of President Wilson, after such a lot of fuss, is read for the moment as a bear-point in regard to Mexican affairs. The argument is that Mr. Wilson's policy in Mexico has been a weak and vacillating one, fomenting disorders in the country instead of restraining them. Mexico Tramways 5 per cent. bonds are 1½ down, at 38½, and the Sixes, at 29½, have lost 4 points. Mexican Light and Power issues remain unchanged. Some say in the Stock Exchange that Mexico cannot possibly get into any worse a situation than prevails now, and that any change must therefore be for the better. But all the same, these people do not buy Mexican stocks.

Marconis have gone back to 2 13/16. The vigorous defence of Mr. Godfrey Isaacs in regard to the Marconi Co.'s connection with the German Telefunken has had no effect in helping the price of the shares, but it has been studied with keen interest. American Marconis and Canadians have scarcely moved; interest is very spasmodic, but there are many who hold that Marconis at the present price will one of these days provide the holders with substantial profits and dividends.

The Anglo-American group of cable stocks is dullish, Anglo-American preferred slipping back to 95; but there has been a slightly better inquiry for the deferred stock on the basis of 23¼. Great Northerns, at 37½, have receded a further 10s. Eastern Extensions show ½ rise, and a fall similar in extent has occurred in Globe preference. West India and Panama Telegraph ordinary shares are unaltered on the dividend announcement of 6d. per share, free of tax, for the half-year to June 30th last. Last November the dividend was 9d. per share.

Underground Electric Income bonds show especial strength, having regard to the prevailing depression of other stocks in the Home Railway market. The price has advanced to 90, and the buying this time has come from the North. The strength of these bonds communicated itself to Metropolitans, which went up to 23, but reverted to 22½. A slight improvement has occurred in Metropolitan deferred stock, which has hardened to 18¼. It may be recalled that this stock was given to holders of the Great Northern & City Railway in exchange for their shares, and ranks level for dividend purposes with Metropolitan ordinary from the first half of 1920. Districts are lower at 15½, while the £10 shares of the Underground Electric Co. are steady, although there has been free buying of the 1s. shares, raising the price to 6s. 6d.

Brazilian Tractions weakened to 54, and Anglo-Argentine Tramways 5 per cent. debenture stock dropped to 69. The slump in British Columbia Electric Railway stocks shows no signs of abatement, and further falls have taken place ranging from 2 to 4½ points, the 4½ per cent. debenture stock being the chief sufferer.

Callenders are 5s. better at 12¾. India-Rubbers rose 15s. to 12¾. Electric Constructions rose to 1 3/32, and the preference are better at 1 1/16. The Edison & Swan shares are unchanged on the issue of the report, and industrials as a whole are steady, with the exception of a few cases in which preference shares have given way a little for the reasons mentioned above. The rubber share market keeps good, and several excellent dividend declarations have played their part in stiffening confidence and prices.

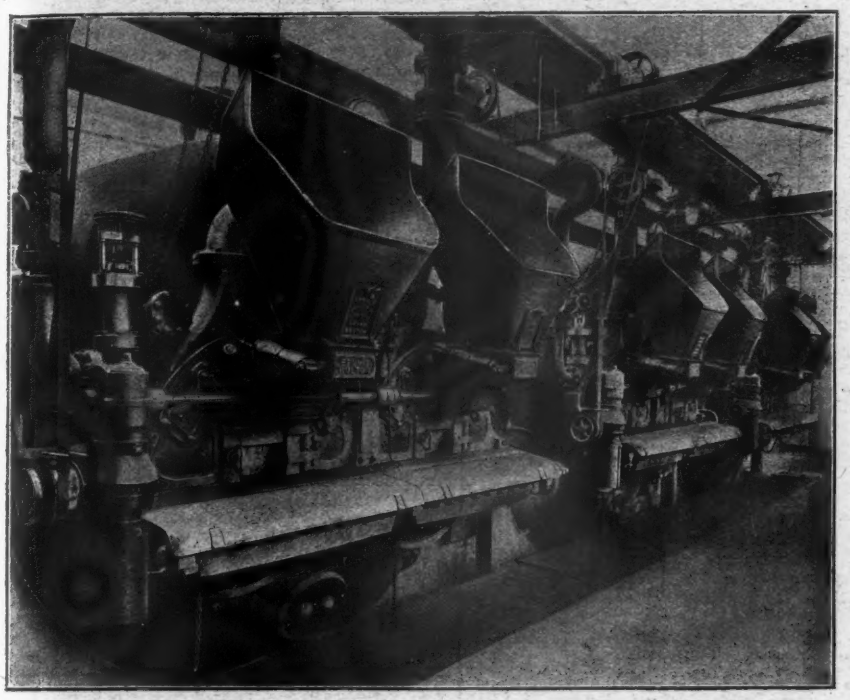
SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1914.	Dividend 1915.	Price Nov. 14, 1916.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	10	10	6⅝	—	£7 11 0
Charing Cross Ordinary	5	5	3⅛	— 1/16	7 2 10
do. do. do. 4½ Pref.	4½	4½	3 5/16	—	6 6 4
Chelsea	5	4	3	—	6 18 4
City of London	9	8	11⅛	— ⅛	6 16 2
do. do. 6 per cent. Pref.	6	6	10½	—	5 17 1
County of London	7	7	10½	—	6 10 3
do. 6 per cent. Pref.	6	6	10½	—	5 18 5
Kensington Ordinary	9	7	5⅝	—	6 4 5
London Electric	4	3	1⅝	—	6 10 5
do. do. 6 per cent. Pref.	6	6	4 7/16	— ⅛	6 15 4
Metropolitan	8½	8	2⅜	— ⅛	6 6 4
do. 4½ per cent. Pref.	4½	4½	3¼	—	7 4 0
St. James' and Pall Mall	10	8	6½	—	6 8 0
South London	5	5	2 1/16	—	6 16 1
South Metropolitan Pref.	7	7	1⅝	—	6 7 8
Westminster Ordinary	9	7	6 1/16	—	5 13 0
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	95 xd	— 1	6 6 4
do. Def.	30/-	33/6	2½	—	7 10 3
Chile Telephone	8	8	7	—	5 14 5
Cuba Sub. Ord.	5	5	3½	—	6 8 6
Eastern Extension	7	8	13⅝	+ ⅛	*6 15 6
Eastern Tel. Ord.	7	8	142½	—	*5 13 1
Globe Tel. and T. Ord.	6	7	12⅝	—	*5 13 0
do. Pref.	6	6	10⅝	— ⅛	5 15 8
Great Northern Tel.	22	22	37½	— ½	5 17 4
Indo-European	13	13	51	—	6 7 8
Marconi	10	10	2 13/16	— 1/16	3 11 2
New York Tel. 4½	4½	4½	98	—	4 10 0
Oriental Telephone Ord.	10	10	2 5/16	—	4 6 6
United R. Plate Tel.	8	8	6½ xd	—	*5 18 5
West India and Pan.	1	—	1	—	—
Western Telegraph	7	8	14½	—	*5 8 4
Home Rails.					
Central London, Ord. Assented	4	4	65½	—	6 2 2
Metropolitan	1½	1	22½	—	4 9 0
do. District	Nil	Nil	15⅝	— ⅛	Nil
Underground Electric Ordinary	Nil	Nil	1 1/32	—	Nil
do. do. "A"	Nil	Nil	6 6	+1/-	Nil
do. do. Income	6	6	90	+ ½	*6 13 4
Foreign Trams, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	4 13/16	—	6 1 6
Anglo-Arg. Trams, First Pref.	5½	5½	3⅞	—	8 9 2
do. 2nd Pref.	5½	5½	2⅜	—	—
do. 5 Deb.	5	5	69	— 1	7 5 0
Brazil Tractions	4	4	54	— 1	7 8 2
Bombay Electric Pref.	6	6	70½	—	6 17 8
British Columbia Elec. Ry. Pfce.	5	5	69	— 2½	7 5 0
do. do. Preferred	—	Nil	51	— 3	Nil
do. do. Deferred	—	Nil	60	— 9	Nil
do. do. Deb.	4½	4½	69	— 4½	6 17 1
Mexico Trams 5 per cent. Bonds	—	Nil	38½	— 1½	Nil
do. 6 per cent. Bonds	—	Nil	29½	— 1	Nil
Mexican Light Common	Nil	Nil	17	—	Nil
do. Pref.	Nil	Nil	31	—	Nil
do. 1st Bonds	Nil	Nil	40	—	—
Manufacturing Companies.					
Babcock & Wilcox	14	15	2⅝	—	5 4 4
British Aluminium Ord.	5	7	28/-	+3d.	5 14 4
British Insulated Ord.	15	17½	12	—	7 5 10
British Westinghouse Pref.	7½	7½	2 7/16	— 1/16	6 9 0
Callenders	15	20	12¾	+ ½	7 17 0
do. 5 Pref.	5	5	4½	—	5 17 8
Castner-Kellner	20	—	8½	—	5 6 8
Edison & Swan, £3 paid	Nil	—	3/8	—	Nil
do. do. fully paid	Nil	—	1½	—	Nil
do. do. 4 per cent. Deb.	5	5	69½	—	5 0 0
Electric Construction	6	7½	1 3/32	+ 3/32	6 16 4
Gen. Elec. Pref.	6	6	10	—	6 0 0
do. Ord.	10	10	14½	—	6 18 0
Henley	20	25	16	—	7 16 3
do. 4½ Pref.	4½	4½	4	— ½	5 12 6
India-Rubber	10	10	12¾	+ ½	*7 17 0
Telegraph Con.	20	20	83½	—	*5 4 7

* Dividends paid free of income-tax.

A DUAL METHOD OF MACHINE-FIRING BY COAL AND GAS.

An interesting example of boiler furnaces which are machine-fired by the dual application of gas and coal is found in the installation carried out by Messrs. E. Bennis & Co., Ltd., at the South Staffordshire Mond Gas (Power and Heating) Co.'s works at Dudley Port, Tipton. The plant comprises eight producers, each capable of gasifying 20 tons of fuel per day of 24 hours, and generating sufficient gas to drive gas engines of 2,000 H.P. continuously. The total capacity of the present section is thus equal to 16,000 H.P.



Boiler Plant with Dual Coal and Gas Firing.

The fuel, brought by boat or by rail, is loaded into bunkers, which automatically feed two conveyors, each having a capacity of 40 tons per hour, which convey and distribute the fuel into the storage bunkers over each set of producers. The bunker over each producer will hold 40 tons, *i.e.*, sufficient to keep the producer working for two days.

The gas, after leaving the producers, is thoroughly washed in mechanical washers, and after passing through the ammonia recovery and gas-cooling towers, is further purified by large centrifugal fans and then passed through the scrubbers and the meters before being compressed and sent through the mains for distribution.

Some time ago it was decided to substitute mechanical firing for hand-firing and machine stokers arranged to burn either coal or gas were installed. These are of the well-known "Bennis" sprinkler type, of which an integral feature is the self-cleaning compressed-air furnace. The boiler plant of the South Staffordshire Mond Gas Co. consists of three Lancashire boilers, each 9 ft. × 30 ft., with extended flues, working at 120 lb. pressure. They are fitted with superheaters, and the gases discharge through an economiser.

A definite guarantee was given by the stoker makers that the evaporation of each boiler should not be less than 12,000 lb. of water per hour, with an overload evaporation of 15,000 lb. per hour, when desired, for short periods, and an efficiency of 72 per cent. was also conceded.

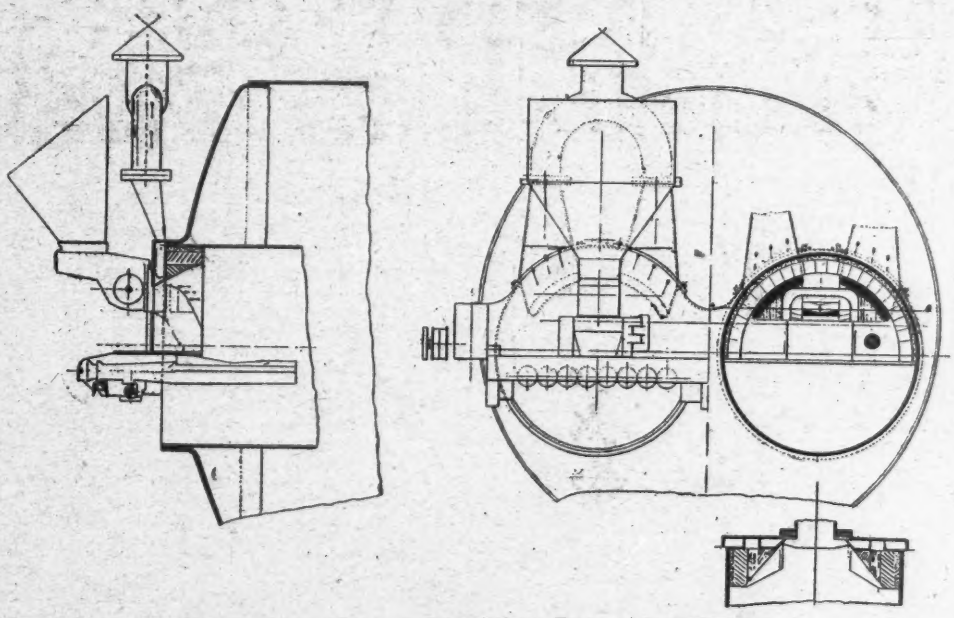
The qualified staff of practical chemists employed by the South Staffordshire Mond Gas Co. were entrusted with the task of taking tests which should establish the results of the work actually done by the boilers. The tests showed not only that the guarantees were maintained, but that an appreciable increase on the figures had been achieved. For instance, an overload evaporation of 17,000 lb. of water per hour from each boiler, instead of 15,000 lb. per hour, was obtained.

The South Staffordshire Mond Gas Co., prior to the installation, had found no little inconvenience owing to the fact that steam was required both during the night and from mid-day Saturday until Monday morning, when it was desirable that labour duties should stand at a minimum.

To meet this condition the mechanical stoker plant was arranged so that it could be coal-fed in the ordinary manner at ordinary times, and the boilers gas-fired during the hours of night and at the week-ends.

A reference to our views will show the gas ducts let into the top flange of the stoker front, and secured by means of a gas-tight joint. The baffler plates, which are situated behind the front, are arranged with a passage, the outlet being over the grate; the gas thus passes from the ducts to the furnace. There are two ducts to each flue; that is, of course, four to each boiler, each pair containing a breeches pipe placed immediately behind the hopper, and passing thence to the gas supply, constituting an extremely simple and satisfactory arrangement. It is, of course, essential that air should have access to the gas; a valve is, therefore, placed on the furnace front with an adjustable cover to regulate the amount of air supply. The air is conveyed into the furnace through a separate air duct, and does not mix with the gas until it reaches the inside of the flue, where ignition takes place.

The results have been such as to justify the firm in applying the idea to all their extensions of boiler plant since the method was first adopted. The fact that repeat orders have been placed for machines of the same pattern to those already supplied for their new installation of boilers, is in itself sufficient evidence of the efficiency of the method and its satisfactory solution of the problem it was designed to meet.



Sectional Views Showing Dual Boiler Firing Arrangements.

In a letter received from the South Staffordshire Mond Gas (Power and Heating) Co., the secretary states that the thermal efficiency obtained during a six months' run under all conditions and variations of load, including times when parts of the plant were off for cleaning and inspection, was 73 per cent. The average quantity of water evaporated per boiler per hour for a month's run was 14,880 lb. During this period the boilers were fired with slack during the day and gas-fired during nights and week-ends.

REVIEWS.

Income-Tax in Relation to Local Authorities. By F. Ogden Whiteley and William Whittingham. Bradford: Wm. Byles & Sons. Price 10s. 6d.

There is room for a work on the dry-as-dust and unelevating subject of income-tax, which is, perhaps, as imperfectly comprehended by some of those who profess to discourse on it as it is by the general public, who seemingly have some of the professional classes, such as the lawyer-politician, the lawyer, the accountant, that singular atom known as the "official mind," and other generally self-seeking and nebulous entities to thank for much of the difficulty and mystery that pervades it, and the anomalies in which it abounds.

The book before us is one that presents to the reader much useful information in an admirably concise form, and should be read by those who are interested in the general working and finance of Municipal Corporations.

There are twelve chapters dealing with income-tax generally within the limits of the title of the book in relation to local authorities. Chapter XIII treats briefly of the excess profits duty, and the book contains by way of an appendix a memorandum which was issued by the Institute of Municipal Treasurers and Accountants explaining the application of the provisions relating to excess profits duty in connection with the trading undertakings of local bodies, and sets forth statements illustrating the methods to be adopted in computing the liability.

The sections and matter which concern us in particular, however (in addition to excess profits), are those covering the ground of the assessable profits of tramway undertakings and electricity undertakings, as well as those discussing the important subjects of wear and tear and obsolescence. These appear to have received due consideration, are presented in succinct expression, as the following example shows, and, on the whole, we are glad to recommend the work.

Statement showing Allowance for Wear and Tear for the Year ending April 5th, 1917.

(Based on accounts for 1915-16.)

Permanent Way—

Miles run / Track mileage (*i.e.*, length of single track) $\frac{6,250,000}{112} = 55,803$ miles per track mile

therefore the allowance for renewal of permanent way is based on an estimated life of 14 years.

Renewals—

$\frac{£4,400}{14 \text{ years}}$ { cost of renewals of one mile of single track } × 112 miles (as above) ... £35,200

Repairs—

	Track mileage.	Cost of repair.
Year ended March 31st, 1912 ...	102	£9,374
Year ended March 31st, 1913 ...	105	10,637
Year ended March 31st, 1914 ...	107	9,832
	314	£29,843

Average for the three years, £95 per mile.
£95 × 112 track-miles (as above)... ... £10,640

Instead of three years, the average cost of repairs may be based on five years, but if five years is taken, this period must be adhered to in the future. In the present case, the average of £95 per mile was first adopted in respect of the assessment for the year 1914-15, and the same average will be applied for each year to April 5th, 1919 £45,840

Cables ... ...
(In this undertaking the power is supplied by the electricity undertaking, and the cables are the property of that undertaking. In those districts where the cost of the cables for tramway power has been borne by the tramway undertaking an allowance should be claimed of 3 per cent. on the written-down value.)

Workshop, Tools and Plant—

Written-down value last year...	£5,800	
Expended during the year 1915-16	350	
	£6,150	
At 5 per cent.		£307

(The written-down value to be carried forward to next year will be £6,150, less £307 or £5,843.)

Standards and Brackets—

Written-down value last year	£38,000	
Expended during the year 1915-16	2,500	
	£40,500	
At 5 per cent.		£2,025

Trolley wiring and connections ... ...
Cars and other rolling stock ... ...
No allowance for wear and tear is made in respect of either of these items, the expenditure upon renewals being charged in the working expenses as, and when, it is incurred. Where, however, the profits of the undertaking are so small as not to cover the cost of renewals, the authority may make a claim to be allowed for wear and tear, and the Commissioners may allow 7 per cent. on the written-down value.

Power station ... ...
Where the power station is part of the tramway undertaking, allowances for wear and tear should be claimed in respect of the various items of expenditure, in accordance with the scheme applicable to electric lighting undertakings.

Total allowance for wear and tear in respect of the year ending April 5th, 1917 ... £48,172

Localisation of Faults in Electric Light and Power Mains, with chapters on Insulation Testing. By F. Charles Raphael. London: *Electrician* Printing and Publishing Co. Price 8s. 6d. net. Third edition.

This well-known work has been out of print for some time, and we are glad to welcome its reappearance in a new edition.

The author points out in the preface that, although improvements have taken place in the manufacture of cables, and changes have occurred in the methods of laying and protecting feeders and distribution networks, faults still develop and have to be tested for and localised. Whereas the main principles of the testing of cables *in situ* and of the localisation of faults remain the same, the particular methods in which they have to be applied under modern conditions have altered, and it has accordingly been necessary to rewrite the descriptions of the methods to be employed in carrying out the tests in almost every case.

Beyond the rewriting of much of the matter of the earlier editions, a considerable amount of new material appears in the present edition. Thus, in Chapter VIII, which deals with "Discontinuities and Short Circuits," a good many instructions for localising the results of burn-outs are introduced for the first time. A short chapter has been added on faults in tramway feeders, and in this some interesting methods are given for employing the trolley wires to form part of the loop or to replace the slide wire in the localisation test.

Another fresh chapter is devoted to the means which have been so largely introduced in recent years for providing duplicate feeders with automatic devices for the protection of the mains, such as the Merz-Price system, the core-balancing and split conductor systems, and the Ferranti-Walters and Callender-Waters protective systems.

The main part of the book is taken up with careful and detailed instructions for carrying out localisation tests for faults under various conditions and by the various known methods. The author has drawn extensively on his own experience in describing the methods to be employed, the special precautions to be observed, and the limitations in the application of each. It is for the actual user of the tests that he writes, and not for the more general reader, who might desire to gain a more comprehensive insight into the principles of cable testing. It is the method of conducting the test, rather than the principles on which it is based, that the author sets out to explain, and he does it very well. The underlying principles are given also, but their interest is secondary, and many special precautions or devices of a practical nature are introduced with little or no explanation of the theory underlying them. In saying this, the reviewer intends no adverse criticism; the author has a particular object in view, and he quite legitimately pursues that object, and omits what he considers to be not essential to its attainment. Thus, on page 51, he is satisfied to state that "a well-insulated concentric system has its outer main at a comparatively low potential, owing to the effect of capacity," without stopping to explain why the capacity produces this result.

In connection with the diagrams Nos. 68 and 69, which show transformers connected in series for breaking down a fault, it might have been desirable to explain the simplification in the connections which would result from the use of a single transformer capable of giving the required pressure.

One piece of advice we are glad to see emphasised by Mr. Raphael in more than one connection, namely, that it is wrong to wait for the development of a fault before making preparations for localising it. As far as possible, the best method to be adopted on the particular system in question, any special apparatus which may be required and calculations of "equivalent sections," &c., for the circuits, should be carefully decided upon and prepared beforehand. It is not

the least of the good points of Mr. Raphael's book that it will be of material help in making such preparations for the day of trial.

Readers of the earlier editions of this book will probably need no fresh assurance of its utility; to any others who have charge of installations where fault localisations may have to be made we can cordially recommend it.

In concluding his notice of this useful and practical work, the reviewer ventures to make one criticism of a general character. He would like to suggest that if the printed matter had been more frequently divided into paragraphs, with fairly numerous sub-headings, and if the diagrams had been provided with titles, the book would have been rendered more convenient for purposes of ready reference. Such a subdivision would also have made it easier to give greater prominence to matters which are common to a series of tests, and which are at present in some danger of being buried amongst the details of the description of some particular measurement. It is only fair to add that by the provision of a good index the author has deprived this criticism of some of the force which it might otherwise have had.

MINISTRY OF MUNITIONS OF WAR.

Procedure Affecting Supplies of Materials.

The Ministry of Munitions is desirous of informing manufacturers, merchants, and exporters that the arrangements that have been in force for controlling supplies of steel, tinplates, &c., are to be extended to other materials, and for the convenience of the public an explanation of the above-mentioned arrangements and their extended application is set forth below.

To obtain, whether for home use or export, supplies of copper wire, cable containing copper, bessemer and open hearth steel, corrugated sheets, tinplates, tinned sheets, terne plates, blackplates and lead-coated sheets, it will be necessary either to quote a Government contract reference and number if the materials are required to execute a Government contract, or to procure a permit reference number and priority classification from the Ministry of Munitions, Priority Branch, 28, Northumberland Avenue, W.C. In applying for such a permit, full particulars of the requirements and purpose should be given. This Government contract reference and number, or permit reference and number and priority classification, as the case may be, must be quoted to the suppliers, who are forbidden to deliver any of the aforesaid materials without being furnished with a Government contract number or reference number and priority classification covering the material ordered.

Where one of the following can be quoted to the suppliers no permit reference number and priority classification from the Ministry of Munitions are needed:—

1. Admiralty contract reference and number or Admiralty Priority Section permit reference and number.
2. War Office contract reference and number.
3. Ministry of Munitions contract reference and number.
4. Commission Internationale de Ravitaillement or Commission Francaise sanction reference and number, with Ministry of Munitions priority classification.
5. Board of Trade (Marine Department) (in the case of mild steel only) permit reference and number declaring merchant shipping to be munition work.
6. Post Office contract reference and number (in the case of copper or copper alloys only).

In the above cases (1–6) suppliers on receipt of the contract or permit reference number and a declaration by the customer that the materials ordered are required solely to fulfil the orders covered by the reference number quoted are entitled to deliver on the basis of priority classification A/4 (war work). If a higher grade of priority is required, application must be made to the Priority Branch of the Ministry of Munitions, stating the ground of special urgency.

The reference, date, and grade of contract permit or priority classification should be passed on to sub-contractors, if any, so that they, like the main contractor, can quote the necessary particulars referred to above on any orders that may be placed with the merchant, stockholder, or the manufacturer of the materials. This means that once a permit has been granted for a certain plant, such permit covers all parts and materials necessary for completing the plant unless instructions to the contrary are entered on the original permit.

As a general rule, the customer should make the application for permit and priority classification, and not the stockholder or manufacturer of the materials.

References need not be insisted upon in the case of urgent Admiralty telegraphic instructions for immediate repairs to ships.

In case of machine tool firms and electrical firms, the order can be covered by quotation of the reference and date of permit accorded by the Machine Tool Department or the Electrical Branch of the Ministry of Munitions respectively, for the machinery or parts for which the material is ordered.

None of the aforesaid materials can be supplied, except for orders or contracts coming within Class "A" or Class "B"; only shell discard quality steel and iron are allowed to be supplied in Class "C" or Class "C" Priority Instruction 6. If required for use within the United Kingdom, shell discard quality steel can be obtained without any permit. If for export, shell discard quality steel can be obtained only where the orders have been classified by the Priority Branch, and the reference number of the classification certificate and specific particulars of destination must be quoted to suppliers and the War Trade Department.

In all applications full particulars should be given under the following headings:—

1. A precise description of the articles or materials required.
2. The exact quantities thereof. If required for different orders or purposes the quantities required for each order or purpose respectively. If required for stock, or "running account," the minimum quantities needed for a period of three months and the respective quantities in hand at present.
3. The name of the firm or firms with whom the order or orders are or are to be placed, respectively.
4. The respective war, national, or other object to be served, and proof of urgency and importance.

A priority certificate is required even though the goods are merely to be transferred from one branch of a firm in the United Kingdom to another branch of the same firm in a foreign country or British possession.

Merchants, manufacturers, and the general public are earnestly requested to assist the Ministry of Munitions in particular and the nation in general by refraining from applying for permission to obtain the materials mentioned herein unless the same are required for war or other urgent national objects. It is essential that supplies should be conserved for direct war work and work of urgent national importance.

Notice in Regard to the Export of Copper Wire, and Cable containing Copper, Bessemer and Open Hearth Steel, or Corrugated Sheets, Tinplates, Terneplates, Blackplates, Tinned Sheets, and Lead-coated Sheets.

1. With a view to conserving supplies of copper wire or cable, Bessemer and open hearth steel, corrugated sheets, tinplates, terneplates, blackplates, tinned sheets, and lead-coated sheets, the Director of the War Trade Department announces that it has been arranged with the Ministry of Munitions that export licences will not be granted unless a Ministry of Munitions priority certificate (Class "A" or Class "B") permitting manufacture or sale from stock has been obtained, or unless the reference and number of an Admiralty contract or permit or War Office contract for the completion of which the copper wire or cable, steel, tinplates, &c., are required can be quoted. Export licences will not as a general rule be issued in respect of copper wire or cable, steel, tinplates, &c., for which a Class "C" certificate is quoted.

2. In the case of allied countries (France, Russia, Italy, Serbia, Portugal, Roumania, Belgium, Japan) priority certificates are only given in very exceptional cases by the Ministry of Munitions, unless the application is supported by the Commission Internationale de Ravitaillement, whether the consignment is intended for a Government contract or not. Application should, therefore, be made direct to the Commission Internationale de Ravitaillement, India House, Kingsway, London, W.C., which, if prepared to support the case, will communicate with the Ministry of Munitions, and arrange for the issue of a priority certificate. If the copper wire or cable, steel, tinplates, &c., are for Government work and export is allowed, the permits for export will be issued by the Commission Internationale de Ravitaillement. If the goods are not for Government work, and the applicant is in a position to quote a priority certificate ("A" or "B") or contract reference and number, he should make an application to the War Trade Department for the grant of an export licence, and if the export is allowed a licence will be granted by that Department.

3. In the case of Sweden, Norway, Denmark, Holland, and Switzerland, application should be made in the first instance to the War Trade Department, which, if there is no immediate reason for refusal, will arrange direct with the Ministry of Munitions for the issue of a priority certificate. The applicant should not communicate direct with the Ministry of Munitions, and the priority certificate will be forwarded to the applicant by the War Trade Department with the export licence. This exception does not apply to bessemer and open hearth steel nor to corrugated sheets.

4. In the case of all other destinations, including British possessions, application for a priority certificate should be made direct to the Ministry of Munitions, Priority Branch, 28, Northumberland Avenue, S.W. No application for an export licence can be considered by the War Trade Department, unless the number of a Ministry of Munitions priority certificate under Class "A" or "B" (or, alternatively, an Admiralty or War Office contract number) is quoted.

5. A priority certificate is required, even though the goods are already manufactured, and even though the goods are merely to be transferred from one branch of a firm in the United Kingdom to another branch of the same firm in a foreign country or British possession.

6. Applicants are warned that the issue of a priority certificate by the Ministry of Munitions is not a guarantee that an export licence will be issued by the War Trade Department.

7. If exporters have any doubt as to the reliability of the proposed consignee, they are recommended before proceeding

to manufacture to consult the War Trade Intelligence Department, Broadway House, Tothill Street, S.W. (as regards foreign countries in Europe), and the Foreign Trade Department, Lancaster House, The Mall, S.W. (as regards foreign countries outside Europe).

AMERICAN EXPORTS OF ELECTRICAL GOODS.

The following figures, showing the exports of electrical goods from the United States during the year ended June, 1915, are taken from the recently-issued trade statistics; figures for 1913-14 have been added for purposes of comparison, and notes of any increases or decreases given:—

	Dollars. 1913-14.	Dollars. 1914-15.	Dollars. Inc. or dec.
Telegraph instruments.—			
To Denmark	—	11,000	+ 11,000
,, Canada	16,000	14,000	– 2,000
,, Central America	14,000	8,000	– 6,000
,, Mexico	9,000	17,000	+ 8,000
,, Colombia	6,000	1,000	– 5,000
,, Argentina	1,000	—	– 1,000
,, Cuba	1,000	1,000	—
,, Brazil	29,000	1,000	– 28,000
,, Other countries	61,000	23,000	– 38,000
Total	137,000	76,000	– 61,000
Telephone instruments.—			
To United Kingdom	55,000	132,000	+ 77,000
,, Canada	432,000	205,000	– 227,000
,, Central America	38,000	56,000	+ 18,000
,, Mexico	23,000	8,000	– 15,000
,, Cuba	82,000	76,000	– 6,000
,, Brazil	336,000	51,000	– 285,000
,, other S. America	140,000	38,000	– 102,000
,, Japan	14,000	6,000	– 8,000
,, Australia	277,000	405,000	+ 128,000
,, Other countries	156,000	172,000	+ 16,000
Total	1,553,000	1,149,000	– 404,000
Other electrical instruments and appliances.—			
To Canada	3,760,000	2,253,000	– 1,507,000
,, Mexico	326,000	244,000	– 82,000
,, Panama	566,000	300,000	– 266,000
,, Cuba	374,000	211,000	– 163,000
,, Argentina	358,000	191,000	– 167,000
,, Brazil	947,000	255,000	– 692,000
,, Japan	483,000	306,000	– 177,000
,, Philippine Islands	244,000	159,000	– 85,000
,, Australia	516,000	623,000	+ 107,000
,, United Kingdom	574,000	1,950,000	+ 1,376,000
,, Other countries	2,292,000	1,660,000	– 632,000
Total	10,440,000	8,152,000	– 2,288,000
Gas engines, stationary.—			
To Canada	144,000	83,000	– 61,000
,, Argentina	26,000	3,000	– 23,000
,, Australia	13,000	21,000	+ 8,000
,, Europe	111,000	51,000	– 60,000
,, Other countries	89,000	262,000*	+ 173,000
Total	383,000	420,000	+ 37,000
* Russia-in-Asia, $197,000.			
Electric motors.—			
To United Kingdom	461,000	292,000	– 169,000
,, Canada	833,000	514,000	– 319,000
,, Panama	221,000	40,000	– 181,000
,, Mexico	264,000	81,000	– 183,000
,, Cuba	131,000	136,000	+ 5,000
,, Argentina	109,000	30,000	– 79,000
,, Brazil	179,000	55,000	– 124,000
,, Chile	93,000	87,000	– 6,000
,, British India	99,000	83,000	– 16,000
,, Japan	829,000	303,000	– 526,000
,, Australia	268,000	634,000	+ 366,000
,, Other countries	1,055,000	564,000	– 491,000
Total	4,542,000	2,819,000	– 1,723,000
Petrol engines, stationary.—			
To Canada	1,009,000	608,000	– 401,000
,, Argentina	200,000	19,000	– 181,000
,, Australia	290,000	180,000	– 110,000
,, Mexico	34,000	18,000	– 16,000
,, United Kingdom	89,000	125,000	+ 36,000
,, Other countries	709,000	250,000	– 459,000
Total	2,331,000	1,200,000	– 1,131,000

	Dollars. 1913-14.	Dollars. 1914-15.	Dollars. Inc. or dec.
Steam engines, stationary.—			
To Canada	190,000	103,000	– 87,000
,, Cuba	38,000	60,000	+ 22,000
,, Mexico	40,000	8,000	– 32,000
,, Brazil	4,000	6,000	+ 2,000
,, Philippine Islands	29,000	—	– 29,000
,, Other countries	437,000	121,000	– 316,000
Total	738,000	298,000	– 440,000
Electric locomotives.—			
To Canada	28,000	110,000	+ 82,000
,, Panama	354,000	158,000	– 196,000
,, Mexico	—	10,000	+ 10,000
,, Bolivia	5,000	14,000	+ 9,000
,, Chile	4,000	15,000	+ 11,000
,, China	34,000	—	– 34,000
,, Other countries	12,000	17,000	+ 5,000
Total	437,000	324,000	– 113,000
Dynamos and generators.—			
To Canada	397,000	246,000	– 151,000
,, United Kingdom	333,000	832,000	+ 499,000
,, Panama	43,000	52,000	+ 9,000
,, Mexico	26,000	36,000	+ 10,000
,, Cuba	235,000	35,000	– 200,000
,, Brazil	136,000	3,000	– 133,000
,, Peru	12,000	35,000	+ 23,000
,, Japan	869,000	301,000	– 568,000
,, Australia	92,000	76,000	– 16,000
,, Spain	182,000	—	– 182,000
,, Other countries	309,000	397,000	+ 88,000
Total	2,634,000	2,013,000	– 621,000
Fans.—			
To Canada	70,000	17,000	– 53,000
,, Argentina	87,000	18,000	– 69,000
,, Brazil	26,000	7,000	– 19,000
,, China	27,000	49,000	+ 22,000
,, British India	47,000	44,000	– 3,000
,, Japan	25,000	19,000	– 6,000
,, Australia	10,000	12,000	+ 2,000
,, Uruguay	17,000	—	– 17,000
,, Other countries	124,000	92,000	– 32,000
Total	433,000	258,000	– 175,000
Arc lamps.—			
To Canada	35,000	10,000	– 25,000
,, Brazil	14,000	2,000	– 12,000
,, Other countries	28,000	19,000*	– 9,000
Total	77,000	31,000	– 46,000
* United Kingdom, $10,000.			
Carbon filament lamps.—			
To Argentina	4,000	8,000	+ 4,000
,, Canada	7,000	11,000	+ 4,000
,, Mexico	98,000	23,000	– 75,000
,, Brazil	10,000	5,000	– 5,000
,, Other countries	53,000	55,000*	+ 2,000
Total	172,000	102,000	– 70,000
* United Kingdom, $10,000.			
Metal filament lamps.—			
To Russia	—	26,000	+ 26,000
,, United Kingdom	—	35,000	+ 35,000
,, Canada	26,000	62,000	+ 36,000
,, Mexico	31,000	20,000	– 11,000
,, Cuba	18,000	74,000	+ 56,000
,, Argentina	13,000	31,000	+ 18,000
,, Brazil	25,000	39,000	+ 14,000
,, Australia	13,000	25,000	+ 12,000
,, Other countries	93,000	161,000*	+ 68,000
Total	219,000	473,000	+ 254,000
* Italy, France, and Spain, $10,000 each.			
Static transformers.—			
To United Kingdom	35,000	37,000	+ 2,000
,, Spain	422,000	1,000	– 421,000
,, Canada	106,000	73,000	– 33,000
,, Panama	137,000	19,000	– 118,000
,, Mexico	99,000	32,000	– 67,000
,, Cuba	55,000	46,000	– 9,000
,, Brazil	148,000	36,000	– 112,000
,, Chile	38,000	10,000	– 28,000
,, Japan	23,000	1,000	– 22,000
,, Australia	47,000	54,000	+ 7,000
,, Other countries	345,000	315,000*	– 30,000
Total	1,455,000	624,000	– 831,000
* Italy, $37,000; India, $99,000.			

Insulated wire and cables.—	Dollars. 1913-14.	Dollars. 1914-15.	Inc. or dec.	Dollars.
To United Kingdom ...	133,000	272,000	+	139,000
,, Spain	112,000	36,000	–	76,000
,, Canada	267,000	137,000	–	130,000
,, Panama	273,000	195,000	–	78,000
,, Mexico	100,000	42,000	–	58,000
,, Cuba	215,000	166,000	–	49,000
,, Brazil	323,000	143,000	–	180,000
,, Australia	121,000	64,000	–	57,000
,, Other countries ...	448,000	857,000	+	409,000
Total	1,992,000	1,912,000	–	80,000

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Substituting Paraffin for Petrol.

A device has been recently invented by Mr. F. A. Wilkinson, of Hatfield, Herts, whereby motor-cars, and internal-combustion engines used for driving electric lighting plants and other purposes designed for running on petrol, can be run entirely on paraffin without alteration to the engine or carburetter. At the existing prices of petrol and paraffin, a saving of about two-thirds the cost of running can be effected.

The chief attractions of Mr. Wilkinson's invention, which is known as the "By-pass" paraffin attachment, are that it is by no means expensive to purchase, and can be fitted up in a very short time, and that the engine can be instantly converted to run on paraffin or petrol by simply opening or closing a valve. In order to vaporise the paraffin to enable a start to be made from cold, an electrical heater is provided which is wound for a suitable voltage, the power consumption being 196 watts for 2½ minutes. After the engine has started, the paraffin and air passing from the carburetter are heated by the somewhat revolutionary method of introducing a small percentage of the exhaust gases direct into the inlet pipe, which, mingling with the paraffin and air, enters the cylinders for a second time.

The attachment has been fitted to stationary engines and to many motor-cars, including Mr. Wilkinson's own car, a four-cylinder Overland, which has now been running entirely on paraffin for the last seven months and continues to give him great satisfaction.

Fig. 1 shows the attachment, in which the electrical heater A is mounted alongside of the carburetter, being held in position by means of a pipe connecting the float chamber with the bottom

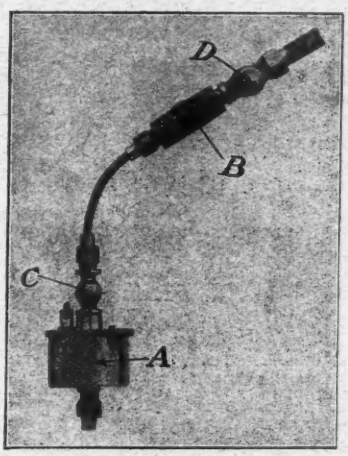


Fig. 1.—"By-pass" Paraffin Attachment.

outlet of the heater; this connection ensures that the level of the paraffin in the heating receptacle is always kept the same as that in the float chamber of the carburetter. Above the heater A is a valve C, connected by means of a small copper pipe to the T-piece B, which is connected to the induction pipe of the engine. The two openings of the valve D are connected respectively to the T-piece and the exhaust pipe; the function of this valve is to by-pass a small portion of the exhaust gases direct into the inlet pipe of the engine in order to heat the incoming charge of paraffin and air from the carburetter. When the attachment is fitted to a motor-car, these two valves are controlled from the dashboard by means of steel wires run in brass tubes, but in the case of a stationary engine the dashboard controls can be dispensed with. For controlling the electrical heater a switch and pilot lamp are provided, the second terminal being usually earthed when applied to a motor-car.

A great advantage of the "By-pass" paraffin attachment is that no petrol whatever is required for its operation, as the electric heater, which is only used for starting purposes, enables the engine to start from cold on paraffin.

Klaxon Factory Signals.

The displacement of steam power in so many of our factories by electricity has led to a demand for a powerful electric alarm operated from the existing supply, and the Klaxon Co., Ltd., of 1, King Street, St. James's, S.W., has introduced a high-voltage type of the Klaxon horn, which can be employed on either D.C. or A.C. circuits at usual voltages. The sound can be heard at a distance of two to four miles, and overpowers the noise made by machinery, while it is so distinctive that it cannot be confused with any other sound. For factory signals, fire alarms, time and danger signals, engine-room signals, burglar alarms, and code signals for calling particular employés to the telephone, &c., the Klaxon is said to be particularly useful.

Reyrolle Combined Switch and Wall-Plug.

Figs. 2 and 3 show the combination of a watertight-pattern switch with a corresponding wall-plug. The switch is of box form, and is made to operate by a rotary action of the lid; it is of a design due to Messrs. Foote & Milne. The wall-plug is of a

Fig. 2. Fig. 3.
Combined Watertight Switch and Wall-Plug.

metal-clad type as made by Messrs. A. Reyrolle & Co., Ltd., of Hebburn-on-Tyne, and an interlock between the two is provided so thatthe plug cannot be withdrawn when the switch is "on."

Fig. 2 shows the switch in the "on" position, and fig. 3 in the "off" position.

THE RÖNTGEN SOCIETY.

The presidential address from the chair of the Röntgen Society was delivered on November 7th by the new President, Captain Thurstan Holland, M.R.C.S., of Liverpool. He devoted himself to discussing the status of the radiologist and the need for organised teaching of X-ray work and electrotherapeutics in the universities and medical schools. As showing the progress which had been made in apparatus, he mentioned that his first radiograph of the hand, taken nearly 20 years ago, required an exposure of 1¾ hours, and now he was able to obtain pictures of the internal structure even of the deeper parts of the human body in a single flash. In the early days the chief desideratum was to obtain a good X-ray negative, but to-day a good negative could be obtained by anybody with modern apparatus, and it was not the photographic technique which was so important now, as the interpretation based on the photographic result. This interpretation could only be carried out by a medical man of exceptional professional attainments, and here Captain Holland made a protest against the placing of lay persons in control of X-ray departments, and against the practice, which he said was a growing one, of surgeons and physicians sending their X-ray work to unqualified people. To his certain knowledge this was done by eminent and even titled members of the medical profession. He claimed for the X-ray department that it was the most important single department in a hospital, and that the cessation of its work would paralyse the hospital's activities. The man who had charge of it must have a thorough knowledge of physics, chemistry, and electricity; he must be to a certain extent an electrical engineer, and he must be well up in medical and surgical diseases, and have more than a little knowledge of certain special diseases as well. While there could be no objection to lay assistants helping in the work of the department, he insisted that no opinion on matters of diagnosis or interpretation should be given by such assistants, no treatment carried out by them on their own initiative, and that the medical head of the department should hold the strings very firmly. He was of opinion that many of the smaller hospital X-ray installations up and down the country, in the hands of untrained medical men or equally untrained non-medical persons, were a constant source of danger to the community, and that the good they did in some cases was far more than counterbalanced by the mistakes they made in others. The time had come to enter a strong protest against the continuance of methods which allowed such anomalies to exist. As to electrotherapeutics, he said that this was becoming more and more important in every direction, and he urged the proper recognition of radiology and electrotherapeutics and the teaching

of these subjects at the hospitals and universities. In many countries this teaching had been organised already, and was being carried on along proper lines. We must not lag behind. America in particular was moving strongly from the X-ray point of view. Here we ought to have a regular system of instruction in X-rays and electricity, both for medical students and post-graduates. He hoped to live to see the time when these subjects would be taught at all the universities and medical schools, their teachers having a recognised status.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

MEXICO.—The translation, recently published by the Board of Trade, of the revised Customs Tariff of Mexico—noted in the ELECTRICAL REVIEW of October 29th—gives the following as the rates of import duty now payable on the undermentioned goods:—

		Rate of import duty. Pesos. Cts.
Bronze, brass, and white metal, in ingots or granulated	kilog. gross	0 06
Copper in ingots or granulated		Free.
Wire of common metal, insulated, of any diameter	,,	0 15
Wire of copper or copper alloys, not covered, up to 2 mm. in diameter	,,	0 15
Wire of copper or copper alloys, of more than 2 and up to 10 mm. in diameter	,,	0 12
Articles of copper or its alloys, not specially mentioned—		
Weighing more than 10 kilogs. per article	kilog. legal	0 30
Weighing not more than 10 kilogs. per article	,,	0 60
Bars of copper or its alloys	kilog. gross	0 15
Armoured and insulated cables and wire	,,	0 05
Cables of insulated common metal, not armoured, and uncovered cable of copper or its alloys	,,	0 10
Pipes and tubes, sheets and plates, of copper, bronze, brass or white metal	,,	0 20
Lead in bars, pigs, or ingots	,,	0 05
Zinc in ingots, filings, or grains, and wire		Free.
Lead in sheets, in tubes, or piping, and glaziers' lead	,,	0 08
Zinc in sheets, not specially mentioned	,,	0 10
Zinc in perforated sheets, for treating ores		Free.
Iron or steel wire covered with cotton, linen, wool, silk, or paper	kilog. legal	0 30
Iron or steel wire more than 1 and up to 10 mm. in diameter	kilog. gross	0 09
Iron or steel wire 1 mm. in diameter or less	,,	0 12
Iron or steel wire cables	,,	0 02
Talc and mica	,,	0 05
Insulators of glass, china, and porcelain, not specially mentioned	,,	0 02
Bulbs for the manufacture of incandescent electric lamps, commutators, switches, contacts and their keys, fusibles, circuit closers, rings, and detents	,,	0 15
Automatic toys operated by spring, steam or electricity	kilog. legal	1 50
Electric arc lamps and separate parts thereof	kilog. gross	0 10
Incandescent electric lamps	,,	0 25
Machinery of all kinds for industrial purposes, and parts thereof	,,	0 02
Belts for machinery, of rubber, and of tarred cotton or hemp	,,	0 20
Rubber footwear	kilog. legal	1 00
Rubber in sheets of all kinds	,,	0 12

Gross weight is the weight of the goods with all receptacles and wrappings, both interior and exterior. *Legal* weight is the weight of the goods, together with the receptacles, wrappings, bottles, and boxes of cardboard, wood, or tin in which they are packed inside the exterior cover containing them all. 100 centavos = 1 peso = 2s. (par value).

PHILIPPINE ISLANDS.—Regulations in regard to the administrative procedure to be followed in dealing with articles imported into the Philippine Islands through the mails, are contained in a recent Customs Administrative Circular (No. 737), the text of which can be seen at the Department of Commercial Intelligence, 73, Basinghall Street, E.C.

ARGENTINE REPUBLIC.—By a recent decision of the Customs Authorities, cardboard tubes for posting catalogues, &c., are dutiable on importation at the rate of 27 per cent. of the declared value.

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

15,434. "Telegraph, &c., poles." F. DOWNES & W. G. YOUNG. October 30th.

15,443. "Battery coils." W. L. WALKER. October 30th. (U.S.A., March 17th, 1915.)

15,448. "Improvements in electrically-propelled rail and road vehicles, applicable also to stationary driving purposes." J. S. WILSON & J. M. WILSON. October 30th.

15,461. "Separator for magnetic ores." W. FRECHEVILLE. October 30th.

15,464. "Igniters for internal-combustion engines." J. F. ALVORD & W. B. THOMPSON. October 30th. (U.S.A., October 28th, 1915.)

15,468. "Wireless telephone systems." THE BRITISH THOMSON-HOUSTON Co. (General Electric Co., U.S.A.). October 30th.

15,500. "Dynamo-electric machines." R. L. CLEAVER & H. E. POTTS, AND SANDYCROFT, LTD. October 31st.

15,516. "Portable telephones." H. W. SCOTT. October 31st.

15,517. "Electric heat radiators." A. F. BERRY. October 31st.

15,541. "Electrographic methods and devices." J. SHEARER. October 31st.

15,543. "Electric circuit controlling devices." SOC. FRANCAISE RADIO-ELECTRIQUE. October 31st. (France, November 11th, 1915.)

15,546. "Dry batteries." BRITISH EVER-READY Co. & A. H. SHEPPARD. October 31st.

15,547. "Radiotelegraphy and radiotelephony." SOC. FRANCAISE RADIO-ELECTRIQUE. October 31st. (France, December 8th, 1915.)

15,555. "Morse signalling apparatus." H. S. DICKSON. November 1st.

15,561. "Electric arc lamps." A. E. ANGOLD & A. H. RAILING. November 1st.

15,596. "Fuses for electric circuits." E. B. HOLT & H. SMITH. November 1st.

15,597. "Commutators for dynamo-electric machines." V. M. ALLEN. November 1st.

15,598. "Processes of making laminated articles." BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING Co. (Westinghouse Electric & Manufacturing Co., U.S.A.). November 1st.

15,623. "Terminal attachment to counterbalance sparking-plug electrode against centrifugal force on rotary aeroplane engines." H. HUMPHREYS. November 2nd.

15,624. "Electrolytic manufacture of metals and/or alloys." E. A. ASHCROFT. November 2nd.

15,643. "Magnetic separators." O. C. JONES. November 2nd.

15,661. "Electrolysis of fused electrolytes." E. ASHCROFT. November 2nd.

15,675. "Wireless telephone systems." BRITISH THOMSON-HOUSTON Co. (General Electric Co., U.S.A.). November 2nd.

15,680. "Locking device for magneto-electric machines." G. W. BARNES, H. KNOX & G. WESTON. November 2nd.

15,712. "Sparking plugs." C. WILCOX. November 3rd.

15,723. "Production of electric light." J. F. SEPULCHRE. November 3rd.

15,730. "Electrostatic induction machine." W. S. FROST. November 3rd.

15,733. "Electric heating and tempering." SNEAD & Co. IRONWORKS. November 3rd. (U.S.A., June 14th.)

15,738. "Electric welding." S. Z. DE FERRANTI. November 3rd.

15,742. "Dynamo-electric machines." A. H. MIDGLEY & C. A. VANDERVELL & Co. November 3rd.

15,773. "Electrical device for giving warning when gas pressure is reduced." T. G. MOORE. November 4th.

15,780. "Switchboards, and manufacture thereof." W. N. RINGROSE. November 4th.

15,781. "Protective devices for electric circuits." BRITISH THOMSON-HOUSTON Co. (General Electric Co., U.S.A.). November 4th.

15,802. "Telegraph key." C. N. DE HORDT. November 4th.

15,803. "Magnetos." SOC. ANON. APPAREILLAGE ELECTRIQUE GRIVOLAS. November 4th. (France, December 27th, 1915.)

15,805. "Unspillable electric batteries." P. D. HOLLINGS & ACCUMULATORS, LTD. November 4th.

15,807. "Insulators for sparking plugs." J. F. BOTTOMLEY & L. SAMPLE. November 4th.

PUBLISHED SPECIFICATIONS.

1914.

13,961. SIGNALLING ON RAILWAYS BY DETONATORS. Compagnie de Signaux Electriques Pour Chemins de Fer. June 9th. (France, June 27th, 1913.)

16,340. SYSTEM OF CONNECTIONS FOR TELEPHONE INSTALLATIONS IN WHICH THE WORK OF THE OPERATORS IS SUPERVISED FROM SPECIAL OBSERVATION PLACES. E. C. R. Marks (Siemens & Halske). July 8th.

1915.

103. DYNAMO-ELECTRIC MACHINES FOR TRANSFORMING ALTERNATING CURRENTS INTO CONTINUOUS CURRENT OR VICE VERSA, AND APPLICABLE ALSO AS DOUBLE-CURRENT GENERATORS. J. la Cour. January 4th. (January 2nd, 1914, Sweden.)

14,482. PROTECTIVE DEVICES FOR ELECTRIC DISTRIBUTION SYSTEMS. British Thomson-Houston Co. (General Electric Co., U.S.A.). October 13th.

14,490. PROCESS FOR THE MANUFACTURE OF HOLLOW SHAPES FROM PHENOL AND FORMALDEHYDE. F. Pollak. October 13th. (Convention date not granted.)

14,498. TIME-LIMIT ELECTRIC CIRCUIT BREAKERS. Akt. Ges. Brown, Boveri et Cie. October 13th. (November 30th, 1914, Germany.)

14,503. INTERRUPTERS FOR INDUCTIVE ELECTRIC CIRCUITS. Harry W. Cox and Co. & J. P. T. Bruggenkate. October 13th.

14,553. GALVANOMETERS. H. W. Sullivan. October 14th.

14,633. DYNAMO-ELECTRIC MACHINES. F. A. Heys (Neuland Patents, Ltd., U.S.A.). October 16th.

14,643. DYNAMO-ELECTRIC MACHINES. F. A. Heys (Neuland Patents, Ltd., U.S.A.). October 16th.

14,729. ARRANGEMENT OF CIRCUITS FOR THE TRANSMISSION OF AETHER WAVES, *e.g.*, THOSE USED IN WIRELESS TELEGRAPHY. A. W. Long. October 19th.

14,851. MAGNETO-ELECTRIC MACHINES. British Thomson-Houston Co. & G. J. Ralph. October 20th.

14,885. DYNAMOMETERS. Heenan & Froude, Ltd., H. Heenan & G. H. Walker. October 21st.

15,142. PRESS FOR MOULDING EARTHENWARE TELEGRAPH INSULATORS AND SIMILAR OBJECTS. P. Simonsen. October 26th. (November 13th, 1914, Denmark.)

15,633. PROTECTIVE DEVICES FOR ELECTRIC CIRCUITS. British Thomson-Houston Co. (General Electric Co., U.S.A.). November 5th.